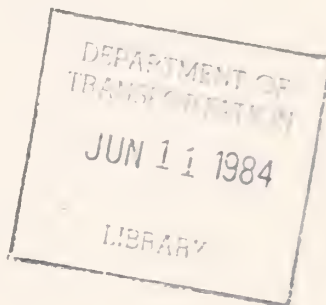


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Highway Programming Issues and Practices

Proceedings of Two Conferences



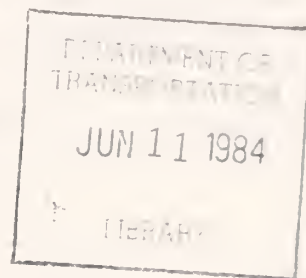
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Highway Programming Issues and Practices:

Proceedings of Two Conferences

Final Report
May 1983

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16. Abstract State legislators, governors, and transportation agency decisionmakers are faced with the problem of how to rationally and equitably allocate limited resources for transportation programs. Accordingly, state departments of transportation are attempting to improve their highway programming process. This report addresses issues of organization and management; intergovernmental relationships and public involvement; financial management; and procedures that relate to programming and prioritizing state highway projects. Sub-issues considered are defining needs and alternative options; resource allocation; marketing and information flow; local involvement; equity; revenue and cash flow forecasting; cost estimating; federal funding; planning input; project prioritization and selection; and project scheduling and monitoring. Case examples of different programming approaches and techniques used by the states are then described. The common elements found in the most workable programming processes are summarized.					
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PREFACE

This report contains a summary of the proceedings of two conferences on highway programming issues and practices conducted by the Transportation Research Board (TRB) under the sponsorship of the Federal Highway Administration (FHWA)—the first took place on December 2-4, 1981, in Washington, D.C., and the other on August 4-5, 1982, in Denver, Colorado.

The primary purpose of the conferences was to provide an opportunity for state highway programming professionals to meet with their counterparts and to mutually discuss programming issues and practices. About 75 professionals representing federal, state, and local agencies, as well as political jurisdictions and citizens groups, attended the conferences.

This report summarizes the current state of the art in state highway programming. The conference planning committee identified issues and specific gaps in programming knowledge that needed to be addressed. [Readers are referred to recent TRB publications related to these issues: NCHRP Syntheses 6 (Principles of Project Scheduling and Monitoring), 48 (Priority Programming and Project Selection), 72 (Transportation Needs Studies and Financial Constraints), 84 (Evaluation Criteria and Priority Setting for State Highway Programs); NCHRP Report 215 (Pavement Management System Development); Transportation Research Records 867 (Transportation Programming Process), 698 (Priority Programming, Finance, and Highway Investment Analysis), 680 (Transportation Finance and Charges, Programming, and Costs); and Special Report 157 (Transportation Programming Process).]

The summary (Part 1) reflects the general views that were expressed at the two meetings. No attempt was made in the discussion to arrive at a consensus or to identify a best solution for any of the issues examined.

In each conference, workshop groups met concurrently to discuss the following broad areas:

- Organization and Management
- Intergovernmental Relationships
- Financial Management
- Programming Process

Each workshop was assigned a specific set of questions within these areas, and the findings of each group were presented at the plenary meetings that followed the workshop sessions. The questions used by the participants appear, along with the respective resource papers prepared as background material, in Part 4 (Eastern Conference) and Part 5 (Western Conference).

The format was the same for both the Eastern and Western conferences. An overview paper and case studies were presented in a plenary session. Small workshop groups then discussed the questions on state highway programming processes. At the Eastern Conference, the perspectives of citizens groups and county and local governments were also presented. At the conclusion of each conference, a plenary session was held so that each workshop group could present a summary of its discussions.

While the format was the same for both conferences, there was a marked difference in the approaches taken by the participants. At the Eastern Conference, the discussions were frequently general and philosophical. At the Western Conference, the participants took a pragmatic, case-specific approach in responding to the questions. Part 2 (Issues and Responses in Highway Programming) and Part 3 (Applications of the Highway Programming Process) reflect the views expressed on similar issues at both regional meetings.

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PART 1: SUMMARY

The plenary sessions and workshop discussions—the general views from which are summarized here—revealed that the programming process operates at various levels of uncertainty and that there are many ways to accomplish the desired results. There is a definite relationship between planning and the programming process. Planning in the more traditional sense should not be ignored for the needs of short-term programming, and a mechanism should be found to integrate planning into the process. It was emphasized that planning and programming represent a continuum, not separate activities, although each has its specific responsibilities:

- Planning identifies system requirements, develops alternative construction and maintenance strategies, and allocates costs among users.
- Programming allocates resources to program and projects and is responsible for project justification and scheduling project development activities.

The following working definition of programming emerged:

Programming is the explicit and visible process within an implementing agency by which management allocates resources and integrates these decisions into the project delivery process of the agency.

A variety of programming processes were described in the workshop discussions and in the resource papers. The most effective (i.e., workable) processes seemed to contain common elements. The common elements found in these processes are grouped below.

ORGANIZATION AND MANAGEMENT

1. Authority, organizational responsibilities, and decision points are clearly defined.
2. Lines of communication are clear, and there is a central point for contact and communication with the staff and the public.
3. Management is accountable for assuring that commitments are met.
4. A common, consistent data base is used to identify needed projects and develop the program.
5. Maintenance and construction plans and strategies are integrated.
6. A project review system is used to provide information, monitor schedules and procedures, chart progress, and identify problem areas.

INTERGOVERNMENTAL RELATIONSHIPS AND PUBLIC INVOLVEMENT

1. A cooperative attitude and a close liaison are maintained with the legislature and the governor's office regarding strategic planning, budgeting, and resource allocation.
2. Good cooperation exists between federal and state agencies at all stages in the process.
3. MPOs and local governments are assisted in developing transportation improvement programs, selecting projects, and seeing that projects are delivered when promised.
4. The roles of citizen and interest groups are clearly defined, and the groups have access to information and input into the programming process.

5. The distribution of resources is based on the public's perception of equity.

6. Potential proponents and opponents are identified and involved in the process at an early stage.

7. Points in the programming process that require coordination and outside review are identified early.

8. Credibility is maintained by keeping decision-makers, legislators, and constituents informed of the alternatives, their effect on the program, available resources, and the consequences of program decisions.

FINANCIAL MANAGEMENT

1. The different functions of programming and financial management are closely linked.

2. A core of stable funding on which maintenance and construction programs may be developed is available.

3. Alternative scenarios are developed for different funding assumptions, and a backlog of projects that can be implemented if additional revenues materialize is maintained.

4. A close surveillance of cash flow and revenue forecasts is maintained, and a process for updating estimates is established.

5. A financial management and review system is used to provide project cost information and update cost estimates on a periodic basis to account for project changes and inflation.

PROGRAMMING PROCESS

1. The process is dynamic and flexible to allow for changes in revenues, project development schedules, and optional federal funding.

2. Projects are identified by evaluating a combination of current roadway condition measurements, traffic service, and safety problem areas.

3. The criteria and standards used to develop programs and rank and select projects are clearly defined, agreed on, and communicated.

4. A pavement management system is used for predicting future roadway conditions.

5. A range of construction and maintenance options are developed and alternative strategies are always considered.

6. Projects are grouped and prioritized by accepted rational criteria rather than by political criteria or funding mechanisms.

PART 2: ISSUES AND RESPONSES IN HIGHWAY PROGRAMMING

Workshop participants discussed in detail the major issues affecting programming and elements of an effective process. The discussions, which are summarized in this part of the report, revealed wide differences in the way each state approaches programming and in the relationships among various levels of governments. Many of these differences are due to such things as the organizational and political structure in each state, the funding mechanism, the jurisdictional responsibility for highways, and the approval process.

ORGANIZATION AND MANAGEMENT

The administrative and legislative structure of a state determines to a large extent the way the programming function is handled. Regardless of the way it is organized, however, a clear definition of programming is necessary. Decision responsibility and the organizational relationships of the programming elements need to be clearly delineated. Lines of communication should be well established between the district offices, the programmers, and the administrator.

Responsibility for some highway needs analysis and project identification can be decentralized to district offices in states large enough to support administrative subdivisions. The feasibility of such decentralization is highly dependent on the organizational structure and the type of project being considered. Spot improvements and signing are the types of local, small-scale projects that may be better identified in the districts, where the staff is more familiar with actual field conditions and specialized design staff is not needed. On the other hand, major system improvements and system prioritization are probably better considered centrally, as are projects that require more complex technical analysis, since it is usually not feasible to have staff with duplicate analytical capability in several districts.

Most states use some type of review committee to evaluate projects. The effectiveness of these groups is determined by their sensitivity to various issues, policies, and concerns; the information on which they base their judgments; and their authority in selecting projects. An iterative process between project design and programming is therefore necessary to accommodate changing political and financial issues and concerns.

Standards

Although traffic and safety considerations are major elements in setting design standards, budgetary and other considerations have created a desire for greater flexibility in applying the standards. The conferees felt there is enough flexibility in the AASHTO design standards to accommodate different functional classifications of roadway for new construction; however, there is insufficient flexibility in applying standards for rehabilitation projects that are more prevalent today.

Currently there is a move to incorporate technically more sophisticated pavement management systems into the programming process. Several states are studying pavement life cycles and doing preventive maintenance—to treat the facility before it fails.

Resource Allocation

Several major project categories compete for available resources, including

- Roadway preservation
- Bridge rehabilitation
- Safety improvements
- Capacity and traffic flow improvements
- Economic development
- Pollution reduction
- System completion projects

Although allocation among these categories is often a political decision, some states use a mathematical formula to achieve their objectives. Sufficient funds are not available for all needed projects in this period of limited financial resources. Further, the choice of allocating funds for a few large projects versus many small projects poses a problem. Consequently, it may be better to spread projects throughout a state rather than concentrate resources in a few high-cost projects even though they may be necessary.

Programming decisions need to consider human resource requirements and administrative costs. Staffing is generally not quickly adaptable to changes in program needs because of such factors as recruitment difficulties, special skill requirements, and retraining problems.

Marketing and Information Flow

Most states reported having some type of public information program; however, two different points of view were expressed regarding the effectiveness of current programs in facilitating the flow of information and establishing the credibility of the state department of transportation (DOT). Several states felt that they were doing an adequate job and that there was no need for improvement. Others said that highway professionals in general did not feel comfortable selling their programs to the public, but that they were going to have to learn better techniques for reaching the public if they were going to compete successfully for funds. All the participating states agreed that good media contact is essential to information flow, but none specified current programs that are particularly effective.

Three keys to maintaining a good relationship between the state DOT and the public were mentioned:

- Develop realistic programs
- Respond to public input
- Get the projects done when promised

The public should be involved early in the process. Objective criteria should be developed and presented to the public through the media and at hearings. These criteria can be based on items such as accident data, bridge inventories, consultant reports on highway capacity, safety, and pavement conditions. Visual aids can be effective in emphasizing problem areas such as deteriorating road surfaces and bridges.

INTERGOVERNMENTAL RELATIONSHIPS

All aspects of programming are affected by the degree to which the legislature is involved in project identification and prioritization. In some states, the legislature is significantly involved in selecting projects, while much is left to the discretion of the administration in others. The trend, however, is toward more legislative involvement because the legislature is frequently concerned with the effects of changing conditions and levels of transportation investment. Furthermore, it is expected that the programming process should be geared to respond to these issues. One suggested approach is to present the program in terms of alternative programs, alternative funding levels, system condition, and impacts of funding decisions by legislative districts. In seeking appropriations, the state highway agency frequently presents a program that shows total needs and options accompanied by a list of the safety, financial, and developmental consequences associated with each alternative.

Legislators feel that they need some control of the process to ensure that constituents are receiving their share. Good communication can play a major role in assuring legislators that resources are used efficiently and that projects will be completed as planned. Suggested approaches include periodic presentations and annual or semi-annual field trips by legislators to see actual conditions.

Capital improvement programs can be effectively presented to the legislature in several ways: by geographic region, functional class, or type of action (preservation of system, new construction). While no framework was selected as most important, flexibility in level of detail and response to the audience were considered vital.

The costs of delayed maintenance need to be conveyed to the legislature. The standard manner is to present statistical information on maintenance operations in the annual budget request.

States indicated that they have a better chance of increasing highway taxes if local governments are involved in the process. And if local governments receive a share of revenues, they will have more incentive to lobby. As a further incentive, the local government share of new taxes might be negotiated—a departure from the traditional split between local and state shares.

Local Involvement

The role of citizen groups and local governments in project identification, priority setting, and evaluation varies by state and by locality within the state. There was general agreement that in most cases the metropolitan planning organizations (MPOs) play an effective role in project selection. It was also agreed, however, that the state should guide project definition and that the local agency should be responsible for the amount and type of citizen participation. In rural areas without formal area planning agencies, the state should deal with regions as intermediaries. There can be a credibility problem at the local level, however, if sufficient funds are not available to complete local projects once they have been established. One state indicated that there is an advantage to having state legislators serve on the policy committees of the local planning agencies.

Equity

Whether taxpayers receive a proportional share of benefits is a troublesome question. The consensus was that there is no precise definition of equity in the programming context. Equity is a perceived concept in which the officials in state legislature and local government and the public feel that they are getting their fair share. Representatives of some states feel it is necessary to use geographic formulas to apportion resources, while others feel such formulas make it much more difficult to deal with relative priorities and needs that might be greater in one area than in another. The formulas or guidelines for dividing funds within a state certainly affect the equity of the programming process and the ability to devise a cost-effective program. While distribution formulas may be a necessity, programmers are in favor of broad policy guidelines rather than rigid criteria to govern their use. The federal highway program objectives will likely continue to influence most state resource allocations and construction program emphases. Equitable allocation of costs among users and other direct beneficiaries is a growing concern at all levels of government.

FINANCIAL MANAGEMENT

Different states employ different financial management systems—cash flow, encumbrance, or modified accrual for receipts and expenditures. Regardless of the system employed, the programming process and the accounting system should be linked for better coordination. The project

delivery system will not be effective otherwise. Programmers should understand the accounting system, and accounting personnel should be well versed in the programming process. The goal should be a fiscal system that allows flexibility in the use of dollars and predictability in fund availability. It should also provide for public accountability.

It is important to achieve stability in funding for highway programs, as unpredictable changes foster inefficiency and reduced productivity. The legislature should have a better understanding of the impacts of funding lapses.

There is a trend toward seeking financial participation, especially from the private sector. Although such participation is generally a by-product of the public involvement process, it is a legislative requirement in some states. The private sector tends to act more quickly than the public sector, which results in a mismatch of the type of action that each participant seeks from the others.

Revenue and Cash Flow Forecasting

The ability to forecast revenues and cash flow is vital to the decisionmaking process, but it involves a high degree of uncertainty, especially under current conditions. These uncertainties include:

- Variation in federal aid
- Inflation
- Fluctuating gasoline prices and consumption
- Declining rate of new vehicle licensing

The assumptions related to these issues should be explicitly defined in the programming process. It may even be desirable to develop alternative scenarios based on such assumptions. Cash flow requirements should be forecast on current and projected commitments of money for all construction projects, maintenance, and other operations of the highway department.

Cost Estimating and Accounting for Inflation

Project delays due to overprogramming contribute to the credibility problem with both the legislatures and the public. It is important to develop a system that provides for accurate project cost information, accounts for inflation, and allows updating on a periodic basis. In addition to providing financial information, the system should account for the progress of each project and provide a comparison of actual progress to the original schedule.

Top management can also approach forecasting changes in the rate of inflation by using historical trends and construction cost indices and by revising the estimates as needed. Long-term inflation forecasting is not meaningful in today's climate of uncertainty.

Project upset limits are an important tool. They identify a dollar or percentage figure that, if exceeded, require reevaluation of a project.

Federal Funding

Congress authorizes money for multiview programs, but the annual appropriations process limits the amount that can be spent on various federally funded programs. A number of consequences result from these federal obligational ceiling limits:

- States frequently cannot meet commitments.
- States cut funding of local projects.
- States need to be prepared for rapid trade-off of projects.
- States need to change priorities to take advantage of discretionary federal funds that are made available.

PROGRAMMING PROCESS

Programming provides information on which transportation policy choices and decisions are made. The programming process should be flexible to accommodate changes in emphasis. The process should be documented and based on explicit policies and needs.

Planning Input

A systematic approach must be employed in identifying highway sections that need rehabilitation, and the road inventory is the most common method used. Such an inventory ranged from informal field surveys to a more formal system that combines a sufficiency index file and mathematical pavement life projections verified by annual field inspections.

Good engineering practice demands that alternative construction and maintenance options, as well as design downscoping, be considered for all projects. A range of options should be provided to the decisionmakers. Some states include a value engineering clause in their contracts. Such a clause allows a project to be modified if a more efficient and less expensive method is found. Of course, the effects of alternative standards and policies may affect the department's potential liability and should always be taken into account when downscoping.

Some states use statewide system planning techniques in rural areas; however, this approach is generally not part of the programming process in most states. The MPOs use systems planning techniques in order to meet federal requirements. Such information is useful in the state programming process. The MPO programming process provides input into the FHWA Section 105 program and to the Transportation Improvement Program (TIP).

Except in some fast-growth states, very little long-range planning is undertaken, and existing long-range plans and programs are being scaled back. States now tend to view the short range (six year) as the realistic timeframe for a program.

Economic conditions and national policy considerations also affect the process. High gasoline prices and inflation affect vehicle miles of travel, which, in turn, affect gasoline tax revenues. Broad policy changes—such as increased emphasis on urban revitalization or attempts to limit urban sprawl—impact the programming process.

Project Ranking and Selection

Technical and engineering criteria weigh heavily in the process of setting project priorities, but other factors also need to be considered. The ranking procedure should accommodate public and political considerations such as economic development, coordination with other work, available funds, and the human resources available for the work.

The availability of funds often determines the sizes and types of project to be selected; that is, financial constraints are now making it necessary to select less expensive alternatives. The criteria used in selecting projects should therefore go beyond standards reflecting the condition of the systems.

Project selection involves the trade-off of different objectives. Analytical methods or priority programming systems can be used to present the information in a rational manner, categorize and catalogue data, and identify the

effects of different alternatives. Some computer techniques can also provide display graphics to illustrate the effects of different program or project alternatives to legislators and to the public. Although such techniques assist program managers in making good decisions, their use cannot replace management judgment when studying the impacts of one action against the other.

Life-cycle pavement analysis is a good technique for determining future rehabilitation requirements and for measuring the cost-effectiveness of each type of improvement, such as determining whether resurfacing or rehabilitating a road is sufficient or whether the surface is sufficiently deteriorated to warrant upgrading or reconstruction. Pavement management systems or pavement serviceability indexes can identify when a section of highway is eligible for either reconstruction or rehabilitation work, which is then verified by field inspections. However, in order to spread limited funds over as many miles of road as possible, many states are performing the least amount of work necessary to keep a roadway serviceable.

The necessity for justifying projects on their own merit has affected the traditional planning and programming process. System preservation and rehabilitation is the priority objective at this time; the traditional view of major system expansion and improvement is no longer financially possible. However, there is a continuing need for a system-wide, case-by-case analysis of capacity improvements, safety improvements, and improvements that address other objectives. One important concern is whether a facility should be rehabilitated without attempting to bring it up to full safety standards.

Categorical federal-aid funding has a major effect on program emphasis and priority decisions. Traditionally, some decisions are being made based on the funding source rather than relative need.

Project Scheduling and Monitoring

It was agreed that there is a need for a dynamic scheduling process. Scheduling is an important part of the programming process, and it is particularly important when the letting schedule is set. Some states allow districts to administer projects and, consequently, officials at the central office level are not made aware of slippages and inflated project costs. Engineers' estimates are sometimes not made public.

Preconstruction manpower availability is a critical factor in the program development process, particularly in the states where there have been dramatic manpower decreases in the past decade.

Some states use very sophisticated computer-based scheduling techniques, while others use less formal approaches. There is a need to group, or batch, projects rather than rank them in a specific order for initiation. The project priority list is not affected by slippages, but it could result in delays to some of the projects on the list. There should be flexibility in the process to respond to a variety of factors that affect scheduling.

Many good programming procedures are currently being used by states throughout the country, and documentation and examples of many of these techniques are available. Dissemination of reports and summaries outlining these procedures may generate a profitable technical exchange. Consequently, a compendium of state programming activities and techniques would be helpful.

PART 3: APPLICATIONS OF THE HIGHWAY PROGRAMMING PROCESS

The conference workshops generated the case examples of different programming approaches and techniques described below. They illustrate the way the process works in different states.

ORGANIZATION AND MANAGEMENT

The Maryland DOT has a 6-year consolidated transportation program, which is updated every year. The program is developed by the State Highway Administration Office of Planning and Preliminary Engineering based on fund allocations and a policy framework established by the Secretary of Transportation. The program is submitted by the State Highway Administrator to the Secretary of Transportation whose staff coordinates the submissions into a consolidated program. The Secretary then approves the total program for submission to the governor and the general assembly.

Beginning in 1978, the Wisconsin Department of Transportation developed and implemented a highway investment programming process, which was used in preparing 6-year highway programs. The department updates its program every 2 years and will expand its scope to cover all modes.

The programming activity in Florida is done in the Division of Administration, which includes the Comptroller's Office, the Data Processing Office, and the Programming and Budget Office. All financial activities have been grouped into one unit in an effort to coordinate activities more effectively. Information flows from programming to project planning, which pulls the two functions together and thereby ensures that feasibility, cost, and environmental concerns will be considered as projects are planned.

Recently, in a major organization restructuring, the Pennsylvania Department of Transportation shifted from its traditional allocation approach of transportation programming to an integrated, organizational approach. This restructuring was accompanied by a parallel realignment of fiscal and systems management functions. Program priorities and key programmatic decisions are now made through the Program Management Committee chaired by the Secretary and comprised of the department's nine top managers. Fiscal implications are analyzed by the Center for Fiscal and Systems Management. Programs are developed by the newly created Center for Program Development and Management, which develops and presents options to the Program Management Committee. The entire process is monitored and managed through a computerized management information system maintained by the Center for Fiscal and Systems Management. The primary products of the system are quarterly letting schedules, and 1-, 4-, and 12-year programs. The 12-year program is required by law and updated every 2 years; quarterly letting schedules are set, and the 1- and 4-year programs are updated continually.

Colorado has a procedural guide that sets forth the organizational responsibilities for its 5-year program. Projects are selected by the District Engineers of the 6 engineering field districts around the state and are reviewed by a 7-man construction budget committee. They must be approved by both the executive director and the highway commissioner. Utah's written procedures define the organizational units responsible for the various aspects of highway programming; a 5-member transportation board approves proposed projects.

In Arizona, programming procedures are written into the law. A priority planning committee develops both the rating formula and the 5-year program. The program must be approved by the Highway Board, and written justification to the governor is required before any change can be made once projects are approved. The Nevada programming

process is also under statutory law, but procedures are somewhat less formal. Each program area prioritizes its own projects. The tentative work plan is then sent to the board of directors and to the legislature. Board approval is required before projects can be added or subtracted. Funds are allocated by a programming division that follows broad goals.

Other states reported less formal procedures. The Governor's Transportation Function Plan is used as the basis of the highway program in Hawaii. Districts recommend projects, which are then selected jointly by the program office and the chief engineer. The list is then submitted to the director of transportation for approval. In Arkansas, the various divisions submit projects for inclusion in the program. Priorities are established in a round-table discussion, and conflicts are resolved in weekly meetings held with the divisions. Funds for each type of project are allocated by the chief engineering and programming officer. Final decision on the program, however, is the responsibility of the Highway Commission.

The states stressed that adequate financial information, good communication, and a clear definition of authority were essential to a successful programming process. It was agreed that the person in charge should be a good communicator, a facilitator, and one who knows how to use authority carefully. Timeliness seemed to be an area of particular concern, and several states felt that individuals should be held accountable for maintaining projects on schedule. Oklahoma suggested reporting as a means of establishing accountability.

Project review procedures vary considerably. Most participating states have a formal review process, although not all have an established committee. The use of formal criteria depends on the type of project. Reviews are governed more by generally accepted standards than by specific criteria.

Many states reported using multiple data bases for program development, project selection, project award, and financial projections. However, they saw this as a problem in establishing project priorities. Iowa has solved the problem of integrating data sources by centralizing the responsibility for project award and by using a common data base for all highway and transportation analysis.

Defining Needs and Alternative Options

The states discussed the different types of planning inputs that are useful in developing programs. Arizona, Iowa, Hawaii, and New Mexico were among the states that reported using needs studies. As input to program development, Maryland uses a statewide needs inventory, the results of systems planning by the MPOs and master planning by the local entities, and the input from local elected officials. The participants maintained that the most effective approach in seeking legislative appropriations combines both the identification of needs and the presentation of a capital program that will fit within a state's financial resources.

A number of states said that they no longer use traditional need evaluation methods and that their criteria and standards have been modified. The trend now is to base needs on system preservation, and some state DOTs have, therefore, returned to the older method of measuring road conditions visually in order to allow for unquantifiable factors in the assessment. Wisconsin specifically avoids the needs study approach of defining deficiencies solely in terms of traditional highway standards. It recognizes that, as a practical matter, definitions of need and deficiency vary from time to time based on a number of factors, including public acceptability of existing conditions, cost of improvements, and revenue availability. Nevada said that its 20-year needs study became known as a "wish list" and that it now uses shorter-range planning techniques, such as deteriorating rates for pavements by geographic areas.

Other states reported the use of longer-range studies as input to their state programs. Washington said that the basis for its program is a 12-year plan that identifies specific work that must be done, but individual projects are not identified in the request to the legislature. In Hawaii, each county is responsible for a 15-year land use plan. In Arizona, corridor studies are used to identify long-term needs. Nevada uses a 12-year plan to advance projects.

The states generally agreed that analysis of the impacts of alternative programs would be useful, but most said they do not have or are only acquiring the ability to do so. Suggested approaches included assessment of various levels of funding at different standards and levels of service.

There was some discussion regarding resource allocation among program options. States reported using many different criteria, but most seemed to involve a statewide system standard, program categories, and the use of geographic boundaries. Matching resources to program options was generally seen as an exercise of subjective judgment. Available analytical tools are just a beginning, and any results from their use must be tempered by subjective considerations and the public's desires. New Mexico said that its constituents were more interested in equitable distribution of projects rather than of funds, and it was important to show that the program responded quickly to the most critical needs of an area.

The participants discussed different strategies used by the states to make adjustments when funds were increased or decreased. Nevada "overprograms" by identifying alternative projects in case some projects are not developed or additional funds become available; early projects are the ones with the highest priority and there is consequently some room for slippage if funds are short. Arizona uses shelf projects if funds become available; Washington calls in consultants to help with unexpected plan preparation. Wisconsin had been able to develop an expanded program when funds unexpectedly became available after a change in state administration. By using the data in its well-developed deficiency and project summary files, it was able to make program choices and necessary adjustments within a few weeks.

Although some states said that in the past they overprogrammed projects to handle additional funds, they did not recommend this approach. Many states said they have stand-by projects to add if additional funds become available and some projects that can be reduced or eliminated if funds are short.

Marketing and Information Flow

A number of states said that they hold public meetings to disseminate information and gain support for their programs. Others felt that meetings conducted by officials were an important means of demonstrating the agency's responsiveness to the public and establishing credibility while still others felt that such meetings were ineffective. They found that people who attend public meetings generally represent special interest groups and that the views expressed are therefore not a reliable cross section.

In Maryland, the Secretary of Transportation, the State Highway Administrator, and key staff visit the state's 23 counties and the City of Baltimore every year after the draft program is published but before it becomes final. The purpose of these meetings is to review all projects, to discuss whether the department has lived up to its commitments of the past year, to solicit local views, to determine whether there have been any changes in local priorities, and to get comments and criticisms from local officials. These meetings are an important step in ensuring that the department's programs are responsive to policies, plans, and priorities throughout the state and in soliciting support from elected officials. The final program is based on the draft program and any adjustments made as a result of the tour.

A few states mentioned other types of activities to gather and disseminate information. In Iowa, 10 citizen

advisory councils provide public input and liaison. Arizona has a Transportation Action Program in which a group tours the small communities to identify areas in need of transportation improvements. Texas also has a local outreach program—a public relations person in each district to sound out local views and disseminate information.

A few states said they had used consumer surveys. Nevada asked its counties to conduct a survey concerning tax increases. Arizona sent out a survey to ask for assistance in identifying what is needed. Arkansas used one of the universities to conduct a survey of citizen views of the state DOT.

Some specific suggestions were made on ways the state DOTs could reach the public and local agencies:

- Mini-reports or memos could be distributed to managers of local agencies to inform them of current issues, problems, and the status of projects.
- In urban areas, MPOs could be used as a sounding board.
- A business visitation program could be initiated to meet with key executives and open new avenues of communication.
- The state DOT could publish annual reports summarizing the various projects.

INTERGOVERNMENTAL RELATIONSHIPS

In some states, such as Iowa, Nevada, and Arkansas, involvement of the state legislature in programming is very limited. Other states reported maintaining very close relationships with their legislatures. In Maryland, the legislature receives the highway program each year as an informational document that supports the budget request. Recent legislation mandates that the program and budget be directly tied to each other to ensure that legislative actions on the budget will have a direct bearing on the approved program. The Hawaii DOT budget is submitted to a legislative committee along with a detailed explanation of why the funds are required. In Arizona, staff are available to assist in developing legislation. Involvement of the Washington state legislature is prescribed by law; the legislature approves the 6-year plan and provides the appropriation, although it does not approve the budget.

Colorado reported that it was concerned about its credibility with the state legislature, which it is trying to improve through a comprehensive program that includes legislative field trips. Iowa has encouraged transportation liaisons for each U.S. senator and representative, and the new transportation director in Nevada is working to establish better communications with the state legislature. In Utah, the state legislature is becoming more involved through the funding of special projects.

The states generally acknowledged that federal funding categories, especially obligation ceilings, greatly affect the level and emphasis of state programming, but none of them advocated losing federal aid to maintain state priorities. New Mexico suggested that the states could increase their flexibility if they set goals to meet their own needs, selected their projects, and then looked through the federal funding categories to match the projects.

Many states said they are involved in federal-aid program development for primary roads and Interstates, but take the "hands off" approach to urban programming, which is generally done by the MPOs and integrated into state Section 105 programs. No specific problems with TIPs were reported, although several states mentioned that they often overprogram TIPs or Section 105 programs for flexibility, to accommodate local needs, and to replace project dropouts.

The participants agreed that consistency with local plans and programs is important, but they generally felt that coordination committees have limited value. They stated

that such committees could be useful for developing allocation formulas and perhaps for developing approval methods.

FINANCIAL MANAGEMENT

Most of the participating states said they operate on a cash basis, although Wisconsin uses the encumbrance method. Some, such as Arizona and Hawaii (because of bond funding), try to maintain a cash surplus; others, such as Utah, try to stay as close to a zero cash balance as possible. Only Nevada reported being on an accrual basis.

Revenue and Cash Flow Forecasting

Many states said they used trend analysis combined with model projections to forecast revenues and that they base cash flow projections on historical records. However, they reported using a variety of approaches for forecasting such things as inflation, rates of growth, and fuel consumption. Computer models, "black boxes," and manual procedures were mentioned, although some states reported unsuccessful results. Participants stressed the importance of quarterly reviews to assess the validity of the forecasts.

Florida described some of the disadvantages of cash flow management. The major problem is obtaining needed flexibility, which is available only in such funds as the state gasoline tax fund, at least to state transportation agencies. Federal aid comes to the states on a reimbursement basis for work already done and paid for and is controlled at the federal level on the accrual/encumbrance basis. Not only are payments to contractors usually made from state funds (with subsequent reimbursement from the federal government), but the state matching share must be available when required to match the federal share at the time payments are made to contractors. Although regularly apportioned federal funds are somewhat predictable, except during periods where new transportation acts are under development, the discretionary and "grab bag" nature of some federal programs causes financial management under cash flow to be extremely dynamic, with significant changes to the plan occurring almost on a daily basis. Even state gasoline tax funds are subject to state categories and other constraints that may prevent cash flow management or at least make it more difficult.

Pennsylvania has recently switched from a bond financing approach to cash financing. Cash flow management techniques have been instituted, and cash flows are now projected 2 years in advance.

PROGRAMMING PROCESS

States have developed different ways to be flexible, although tight manpower has eliminated some of their flexibility. Breaking projects into small parts increases flexibility because the phases can be moved faster. Overprogramming is common and allows for slippage, and many states program additional projects that can be implemented if additional funds become available. Nevada, however, has found that this requires an excessive amount of funds and has thus reduced the number of additional projects. Iowa breaks projects into small parts and develops those that might qualify for discretionary funds, but it reports that manpower has become a problem.

Establishing Priorities

The states reported many different ways of measuring current conditions as a first step in establishing priorities. New Mexico said that it studies average daily traffic (ADT), accident rates, pavement strength, geometrics, functional class, and capacity and then applies other socioeconomic factors to identify projects for implementation. Methods used by other states include skid measurements and visual observation of cracking, patching, and rutting.

There was some discussion of threshold values that identify project need. The participants agreed that consistency is the key. Oregon uses a pictorial method that ensures statewide consistency in condition ratings.

Most states said that they have clearly defined criteria for establishing priorities and initiating highway projects. A number of them have very formal systems that use criteria established in pavement management systems and safety programs. Washington maintains an inventory of the entire highway system and determines a statewide priority array based on factors such as volume/capacity ratio (V/C), bridge conditions, pavement condition, and hazard ratings. Iowa uses sufficiency ratings (a rating of 50 would trigger the project, but 20 is the programming point), pavement condition ratings (3.0 PSI on the Interstate would trigger the project), and FHWA bridge ratings criteria. Arizona uses a pavement management system and a construction rating system that rates all road mileage according to 12 factors.

Maryland uses technical criteria—safety hazards, structural condition, and service levels—but uses these criteria differently in evaluating various kinds of projects. The role of technical measures in determining priorities is very high for projects that are based on safety and structural criteria. The State Highway Administration has a variety of quantitative measures, formulas, and standards to determine which safety projects and which structural projects are the most critical and should receive the highest priority. In comparison, projects based on service levels are affected to a moderate extent by technical measures. Priorities for the secondary highway program are treated as matters of policy under state law, which stipulates that the department must undertake secondary highway projects in the order established by elected officials.

Maryland's system for establishing priorities also uses a breakdown based on project type, roadway category, and funding. Highway maintenance has top priority within the operating program. Minor capital improvements involving resurfacing, safety, traffic control, and bridge rehabilitation have the highest priority claim on capital funds. Completion of Interstate gap sections is next in priority, followed by major capital projects to improve capacity and safety on the states' primary and secondary systems.

Wisconsin uses its computer information system in developing program priorities and alternatives. Deficiency data provide original input to the system. These data include surface age and pavement condition, accident rates and occurrences, volume-to-capacity ratios, percent non-passing zones, and other geometric and structural criteria. From this file, a series of deficiency reports are produced, summarizing the extent and severity of various deficiencies statewide and by district, functional class, etc. Once the screening of deficiencies in the state highway system is completed, alternative improvement projects are developed for those segments judged most deficient. Emphasis is placed on those segments with safety, geometric, and capacity deficiencies that also require surface renewal within the 6-year period. The minimum improvement alternative for each segment is resurfacing or resurfacing with the minimum structural renewal necessary to support a new surface. Depending on the severities, higher levels of improvement vary from minor reconditioning projects to major reconditioning, reconstruction, and major projects on new alignments. The alternatives also vary according to the program parameters assumed (overall revenue level, allocation of revenue by district, subprogram emphasis, etc.). Data on the key design elements, potential impacts, cost estimates, and schedule are collected and placed in a computer file, which could be cross referenced with the deficiency data file to produce summaries of the deficiencies addressed by different sets of projects and programs. Some consideration is given to specifying relatively rigid rules or priority thresholds (e.g., accident rate above a specified level, etc.) for projects proposed for higher-level improvements. However, subject to meeting surface re-

newal goals, districts are given wide latitude to set priorities within set dollar allocations.

Other states reported using less formal systems. Hawaii uses sufficiency ratings and visual inspection. In Colorado, projects are identified by districts, but this is likely to change. The Department of Highways is developing a system to identify projects on a statewide basis by assessing needs and getting district input.

None of the states said that they have defined minimum standards for the public. They feel that public perception of acceptable minimum standards is too subjective and varied. It was felt that there would also be a conflict between the technical minimum standard and the public's perception of what an appropriate standard should be.

PART 4: EASTERN CONFERENCE

ISSUES ADDRESSED

A. Management Issues

1. Organizational Approach

- a. Can needs analysis and/or project identification be decentralized to the districts? Which programs should be developed centrally to assure system continuity and reflect statewide requirements?
- b. Some states are setting up formal project review committees to evaluate each proposed project and decide which of the alternative solutions should be selected. How well does this procedure work? Are there formal criteria for making decisions?
- c. How do you fit the programming functions into the organizational structure so that there are good lines of communication and clear definitions of responsibility?

2. Legislative Involvement

- a. The legislature wants to know what may happen under different conditions and levels of transportation investments. How can you develop the programming process to respond to the what-if questions?
- b. How do you assure the legislature that resources are being used efficiently and that projects will achieve their objectives?
- c. What role does the legislature play in project identification and prioritization?
- d. In seeking appropriations, which approach is more effective, the identification of total needs or the presentation of a proposed capital program that is realistically constrained by staff workload and schedule factors?
- e. How should capital programs and needs be presented to the legislature, e.g., grouped according to preservation and betterment, geographic region, or function?
- f. How do you identify for the legislature the costs of delayed maintenance?
- g. Since in most states, county and local government share in highway user tax revenues, what role should local government highway programs play in the state's approach to the legislature for additional highway resources?

3. Local Involvement

- a. What roles do citizen groups and local governments play in project identification, setting priorities, and evaluation of alternatives for developing local TIPs and state programs?

- b. What the public does not understand they usually will not accept. How do you define needs or projects so that the public will accept your criteria?
- c. How much should evaluation procedures depend on measurable engineering data and on local desires or complaints?

4. Equity

- a. Highway programs must ultimately be based on some attempt at equity. How do you define equity? In terms of equity, how do you decide whether to allocate resources based on traffic, economic development, population, geographic area, opposing interest groups, or other criteria?
- b. How do you respond to the allegation that those who will pay the taxes will not proportionately receive the benefits?

5. Program Areas

- a. In defining broad construction program areas, should they be by federal funding category, functional classification system, traffic volumes, type of construction (e.g., pavement, bridges, signing, lighting, painting), or preservation, betterment, and safety?

6. Standards

- a. Traffic and safety considerations are major elements in setting design standards. The federal design standards substantially affect the reconstruction as well as new construction costs of highways. Should these standards be varied for different functional classes of highways and with different traffic volumes? If so, how and what impacts will this have on the programming process? What are the legal implications of downscoping design standards?
- b. How are pavement management systems integrated into the programming system?

7. Resource Allocations

- a. How should resources be allocated among major elements such as roadway preservation, bridge rehabilitation, safety improvements, increasing capacity and improving traffic flow, inducing economic development, and reducing pollution? Are there any rational criteria or are these allocations based primarily on political pressures?
- b. On what basis do you allocate resources among the districts as geographic regions, e.g., need, formula, political equity?
- c. How do programming decisions consider manpower requirements and administrative costs both centrally and in the districts for each project?
- d. Given limited resources, how do you decide between allocating resources for a few large projects or many small projects?

B. Fiscal Issues

1. Financial Management

- a. Some states are on a cash disbursement basis, some on an encumbrance system, and some on a modified accrual system for receipts and expenditures. What are the benefits and liabilities of each system? How do they affect each flow problem?
- b. States that have general fund support for their highway programs may have problems with the lapsing of funds. In such instances how can such states achieve a stable program and prevent loss of funds?
- c. The equitable allocation of costs among users and other direct beneficiaries is a growing concern at both the state and the federal levels of government. If those receiving the benefits should be more responsible for the costs, what analysis is being made of the beneficiaries of a project and who will proportionately bear the cost in terms of users and non-users?

2. Revenue and Cash Flow Forecasting

- a. How do you forecast revenues?
- b. How do you forecast cash flow requirements?

3. Cost Estimating and Accounting for Inflation

- a. How are costs reflected for projects not to be built in the near future? How are these costs updated through the project development process?
- b. In developing needs studies or project lists (i.e., 1-, 5-, 10- and 20-year construction programs), how do you forecast changes in the rate of inflation? Should you use a growth, decline, or constant rate of inflation and level of program? Do you consider how inflation varies with cost components, i.e., labor, materials, etc.?
- c. Are project "upset limits" an effective tool? How do you apply them?

4. Federal Funding

- a. In terms of programming, what consequences have resulted from the limitations set on rates of expending federal aid funds or withholding federal aid funds?

C. Programming Process

1. The Process

- a. How do you make the programming process flexible so as to accommodate changing emphasis and changing decisionmakers?

2. Planning Input

- a. How do you identify the highway sections each year that must be rehabilitated in order to keep the highway system at its current service level?

- b. How do you downscope projects and evaluate alternative construction and maintenance options for a proposed project?
- c. How does programming for 5, 10, or 20 years reconcile with system plans or other planning efforts?
- d. What real input does the TIP planning process have on programming?
- e. How do you incorporate national, regional, or local factors such as rapidly developing or declining economic conditions, modal shifts in goods movements, and conservative political climate into highway programming?

3. Project Selection

- a. What criteria are used to select projects and how are they used in evaluating them? How do they differ for different highway programs? What criteria are used in weighing one element or one type of project relative to others—for instance, safety relative to surface conditions or bridges to pavement resurfacing?
- b. Key to pavement life-cycle costs is an evaluation of alternatives that rely heavily on initial high-cost, long-life improvements or on incremental periodic incremental improvements. How do you compare the life-cycle costs of alternatives?
- c. How do you forecast pavement life expectancy for existing pavements? How do you identify projects and schedule them to enhance pavement life expectancy?
- d. How do you determine when a pavement repair or renovation project is sufficiently costly to warrant reconstruction and upgrading of road geometrics?
- e. How should maintenance activities such as chip sealing be included in the programming process since they affect pavement life?
- f. Projects must now be justified and defended on their own merits as well as links in system development. How has this affected the planning and programming processes?

4. Project Ranking

- a. How do you rate and prioritize roadway bridge, safety, and other types of projects?
- b. To what extent should project prioritization be based on technical and engineering criteria compared with public complaints and political considerations?

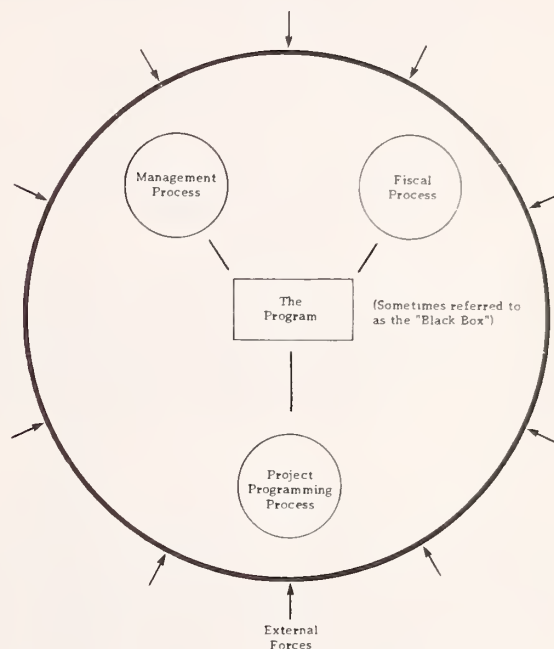
5. Project Scheduling and Monitoring

- a. How is the project priority list updated to take care of slippages and inflated project costs? How are slippages identified?
- b. Preconstruction manpower availability is a key element in project scheduling. How are preconstruction manpower requirements scheduled?

- c. Should projects be batched in terms of scheduling since there may be delays in one or more of the preconstruction activities? Some states have attempted to establish a specific order of construction. What problems has this procedure caused, and how have they been resolved?
- d. How are emergency projects handled in the programming process?

ent perspective. When the conference planning committee met last summer to develop the agenda for our meeting, we discussed several such definitions and then concluded that there are four elements in the highway programming process that, taken together, define and describe the details and complexity of that process. These elements, shown schematically in Figure 1, are as follows:

Figure 1. The programming process.



PAPERS PRESENTED

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INTRODUCTION

The purpose of this paper is twofold: to describe briefly the problems and issues of establishing state highway programs; and to place those problems and issues into a reasonable and manageable framework that can be addressed by the participants at this conference. The first step, however, is to define the meaning of "establishing state highway programs" so that all participants will have the same basic concept in mind.

Several research efforts and state-of-the-art reports on this subject have been completed and distributed by the Transportation Research Board (TRB) and the Federal Highway Administration (FHWA) during the past several years; some of the key reports are listed in the appendix to this paper. Many have included a definition of highway programming, but one of the most concise and simplest is the one included in NCHRP Synthesis Number 48:

"Programming is the matching of available projects with available funds to accomplish the goals of a given period."

This definition has withstood the test of time for about four years. However, the implication of some of the words, the "goals of a given period," for instance, have changed since 1977.

The programming should not be confused with planning and setting priorities. The term "planning" has several different definitions. Again, NCHRP Synthesis 48 cites the most commonly used definitions:

- Policy planning
- Systems planning
- Comprehensive planning
- The transportation plan
- The long-range transportation plan

The definition of "planning" will probably continue to be a subject of debate. To arrive at a definition that will not divert our attention at this stage, let us simply say that transportation planning is a systematic process of projecting future transportation needs.

The term "setting priorities" (or prioritizing) has been defined, again by NCHRP Synthesis 48, as "The overall process of producing a rank order of priority projects and project sections, using technical and nontechnical, quantifiable and nonquantifiable factors as the criteria for ranking."

These activities—planning, priority setting, and programming—should all be considered as an integral part of the process of establishing highway programs.

Other definitions of highway programming have also been used; each describes its aspects from a slightly differ-

- The management process
 - Establishing objectives, policies and overall program directions
 - Establishing investment strategies and program levels
 - Allocating resources to geographic areas and program categories
 - Identifying priorities systematically
 - Identifying special categories for high priority attention
- The fiscal process
 - Projecting revenues and cash flow, both short term and long term
 - Establishing program budgets
 - Matching revenues with programs and budgets
 - Establishing and implementing program and budget controls
- The project programming process
 - Identifying and matching specific projects with funds available for a specific period of time
 - Scheduling those projects for implementation
- The state highway program
 - The above three elements, working in combination, contribute to the state highway program. The program is usually a printed document that is made available to the state legislature, local officials, and citizens. Its purpose is to inform all interested and concerned individuals and organizations of the manner in which available funds will be used for the specific time period covered by the program. It is worth mentioning at this point that the program is often viewed as a "black

box" by those outside the immediate programming process. That is because there is often uncertainty or even mystery concerning exactly how it is established.

There is continuing feedback among the four elements of the overall process, and each element is constantly affected and influenced by numerous external forces that include:

- National inflationary trends
- National and local economic advance or decline
- National and local political climate
- Modal shifts in goods movement
- National regulatory policies
- Energy costs and availability
- Federal participation in funding programs
- Availability of an adequate number of public employees
- Shifts in emphasis from new construction toward the preservation of the existing system
- Influences from legislative bodies, and from public and private interest groups

As part of the preliminary work to prepare for the conference, two planning meetings were held (one in the East and one in the West) to discuss the issues, problems, and frustrations facing those who are responsible for and interested in state highway programming. Those issues are summarized in the paper "Issues to be addressed at the Highway Programming Workshop" (hereinafter referred to as the Issues Paper).

THE CURRENT STATUS OF HIGHWAY PROGRAMMING

If we accept the definition of programming and the programming process described earlier, most state highway programmers would agree that the highway programming process in many states has reached crisis proportions. The number of desirable projects is far outdistancing available funds with which they are to be matched. However, the public, which is not directly involved with the highway programming process but which every day experiences peak-hour congestion, cracked pavement, potholes, decaying bridges, and unsightly roadside appearances, quickly concludes that public agencies are badly mismanaging available highway funds.

Members of legislative bodies (at state and local levels) look at the situation from a third perspective. They are constantly faced with requests from all the program managers for more money. The solution to most problems always seems to be more money and more people. But, our legislative leaders must respond to their constituents who want both tax relief and the provision of the same levels of service to which they have become accustomed. This translates into a demand for better management of available resources.

Which view is correct? The answer is that there is truth in each viewpoint. What we have then is a mixed and probably confused interpretation of what the problem really is. We also have a large number of perplexed, harassed, and frustrated individuals in government, as well as many citizens who depend upon government to provide them with highway services.

The problems we are addressing are worth highlighting:

- Inflation has seriously eroded the value of the constant dollars available for highway programs.
- Those states that rely on the gas tax as the stable source of funding for highway programs have experienced a decline in the rate of growth of those dollars because of improved auto fuel economy, reduced travel, and a general trend towards energy conservation.
- Many state highway and transportation agencies have deferred the maintenance of pavement and bridges in order to expand and build new facilities.

The result has been a serious backlog of maintenance needs.

- Many state highway and transportation agencies suffer from a serious erosion of credibility among the public and state and local elected officials because the agencies have failed to produce on earlier promises.
- Bad programming decisions have been made in the past. These have resulted in criticism of the programming procedures used in some states.
- There are so many potential projects requiring funding that it has become virtually impossible in some states to distinguish among equally important priorities. This is the "shooting the fish in the barrel" syndrome—fish are caught but not necessarily the ones you want.
- Many states are well managed, and their programs show it. Others are not so well managed, and their programs also show it. However, even in those states that have traditionally emphasized good management, there is great concern that it will be difficult to continue to maintain adequate highway systems.
- There is increased competition for funds for all public programs, and many citizens and legislators wonder why so much money is spent on highway programs when they do not see great benefits accruing.

We shall hear the opinions of citizen, county, and local government participants in the programming process later this morning. They will provide you with their own perceptions of the problems as they see them. We shall also hear from four state programmers. These discussions will also help to put the issues into perspective.

Some Reasons Why A Conference On Highway Programming Is Necessary

I have had the opportunity to deal directly with the highway programming issues we shall be discussing at this conference and to discuss many of those issues in some depth with programmers and top managers in a large number of states. In addition to my own experience and observations, the planning committee for this conference spent a considerable number of hours identifying problems and concerns on this subject. Based upon all of the above, following are my perceptions of why this conference is necessary:

- Good management, a systematic way of identifying needs, and a credible process for equitably distributing available funds are essential. In states where these are emphasized, there are still many problems, but there seems to be less of an atmosphere of management by crisis.
- The process through which a project proceeds from concept to implementation can be so long that by the time a project is ready for implementation, a new philosophy may have taken over the reins of government or there may be simply too many competing needs for the same dollars. Thus, a high priority project of five years ago may now be a low priority.
- Many appointed state transportation managers feel that they have little or no control over what projects are implemented because earlier commitments and the momentum of many years of work on a particular project become the overwhelming forces in determining priorities.
- Citizens, local officials, and state legislators often feel left out of the priority-setting process and, consequently, left out of the "real" programming process.
- Substantial resources are being spent to support various state, regional, and local planning activities, but in many states those planning activities

have little or no impact on how highway programs are established.

- Many states are having difficulty funding even their highest priority maintenance needs.
- Efforts to obtain additional state funds have fallen on deaf ears in many states because legislatures have established other higher priorities that have earned their way to the top of the list. This could also be due to the inability of the state highway agency to convince the legislature that additional funds can be spent wisely.
- There is a sense of uncertainty about the level of federal support that will be provided to the states in the future.
- There is a sense of confusion concerning the difference between planning, setting priorities, and programming, as well as how the three relate.
- There is a sense of uncertainty concerning the role and influence of the programming process and documentation established by FHWA regulations vs. the "real" process.
- Citizens, legislators, and local officials are frequently not sure what criteria are used in establishing priorities.
- The definitions of maintenance and capital improvements are becoming less and less clear.
- The role of elected officials in highway programming is becoming more and more significant, since they are the ones who must be convinced concerning the need for more funds.
- Meanwhile, potholes are getting bigger, bridges are being closed, grass mowing is being curtailed or eliminated, and new highways are taking longer to build.

We could probably fill another dozen or so pages with a summary of observations, problems, and issues. Fortunately, the conference planning committee has spent considerable time doing this for us. The Issues Paper included with the conference materials summarizes the major issues and has placed them into the following categories:

- Management issues
 1. Organizational approach
 2. Legislative involvement
 3. Local involvement
 4. Equity
 5. Program areas
 6. Standards
 7. Resource allocations
- Fiscal issues
 1. Financial management
 2. Revenue and cash flow estimates
 3. Cost estimation and accounting for inflation
 4. Federal funding
- Programming process
 1. The process
 2. Planning input
 3. Project selection
 4. Project ranking
 5. Project scheduling

If another group were to go through the same exercise, it might arrange those issues another way, but the same issues would no doubt be identified. The purpose of the workshop sessions is not to repeat the work done by the conference planning committee in deciding what the problems are, nor is it intended that we leave the conference with a reorganized list of categories. Further, I do not

believe we should attempt to define a model programming process. We should, instead, focus on how to resolve these issues that have been identified. I suggest that we can best do this by discussing how the highway programming process works now in specific areas, what is wrong with it, and ways it might be improved. We should, in my view, begin by looking at the big picture. We should examine such questions as:

- If highway programming is such an important, high-priority subject, then why do so many states still do it by the seat of their pants?
- If we are spending so much money on planning, why aren't the products of the planning process used in making programming decisions?
- If there really are high-priority maintenance and capital needs, then why aren't state legislatures willing to make more funds available?
- If we need better management on current highway programs within current constraints of reduced budget and personnel, what kinds of changes are needed to accomplish that goal?
- What are the criteria that should be used by programmers to produce an equitable distribution of funds that will be perceived by all as being fair?
- How do we clear up the confusion that exists in the minds of citizens and elected officials who are never quite sure how the process works?
- Can an acceptable and firm one-year and multiyear program be established that will be credible (as viewed by people in the agency as well as those outside the agency) and capable of implementation?
- What kind of flexibility can or should be built into such a "firm" program to allow for emergencies, changes in political or management philosophy, and changes in the economic climate?
- What justification is there for establishing stable funding for state highway programs when other state programs usually do not have such a luxury?
- What criteria can we use to judge whether or not any programming process is producing a beneficial program?

After looking at the questions, we should then examine the detailed questions contained in the Issues Paper to see how these might be resolved. We can then start to formulate some specific suggestions.

CONCLUSIONS

In most states, there is currently little discretion in how funds are allocated for highway programs. Previous commitments—legislative mandates, formula allocations, the desire to match federal funds, emergency situations, overwhelming maintenance needs, and the like—use up all or most of the available funds. In addition, there is a growing number of states that simply do not have adequate resources to deal with more than the minimum requirements to finish partially completed projects and to deal with emergencies and routine maintenance.

The consensus that clearly emerges when talking to state highway programmers is that the demand for highway improvements is increasing much more rapidly than the funds available. Consequently, everyone in a state feels cheated; that is, they feel they are not getting their fair share of the funds available for highway programs. One state programmer commented that perhaps the best that can be hoped for is that everyone will feel equally cheated!

The current era is one of tight federal and state budgets—a comment that has been used in nearly every report on this subject for the past decade. However, the past several years have been characterized by high increases in costs that state transportation revenues have not

matched. Thus, the problems of the past few years have been particularly acute.

However, the fact that we are experiencing a period of fiscal austerity in all federal and state programs has made us more aware of the problems we must address. Assuming we do need more money to maintain acceptable levels of highway services, a basic question is: "How can we use our money wisely?". If we give the impression that more money means that all those problems will go away, we may end up with a new problem—decreased credibility.

If there is, in fact, a need for more highway funds, and if highway agencies are authorized to spend more money, there will be increased pressure to establish and use selection criteria and a programming process that will be viewed as fair and equitable. It will also be necessary to take advantage of improved and available management tools to better monitor what is happening to ensure that the desired results are achievable.

There have always been and will no doubt always be inadequate funds to accomplish all that we would like to do. For highway programming purposes, the challenge is to establish and execute a systematic process that will result in the equitable distribution of available funds (limited though they may be) to provide reasonably efficient and safe highway facilities in the most cost-effective manner possible.

The objective of this conference should be to make some specific recommendations on how this can and should be done.

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ROBERT W. SWIETYNIOWSKI
State Legislative, Local Government
and Citizen Perspective

I am responsible to the electorate for the condition of the roads in my city. I hear from taxpayers about traffic noise, safety hazards, traffic congestion, snow removal, and I am

responsible whether the road is a federal-aid system highway, a state route, an Interstate, or an alley.

As president of an MPO system, I lead the transportation planning process; I participate in assigning federal and local dollars to keep the highway systems in the greater Cleveland area functioning. In these roles I have learned about highways—what it takes to build them and what it takes to maintain them.

Last year, the Ohio Association of Regional Councils and the State Department of Transportation formed a small task force to determine how to deal with the shortfall in highway funds. As this task force met, the enormity of the highway problem became clear. We spent the year defining the word "programming." As a result, the state of Ohio now includes local elected officials in its decisions on how to assign funds and how to best use the available federal monies.

We are now working with state legislatures and our delegation in Washington to cope with the immense challenge of keeping up with highway needs. We succeeded in getting a gas tax passed in Ohio; yet our funding problem is bigger than ever. Our needs are painfully apparent. We have bridges near collapse. We spent the first portion of our Interstate substitution fund to repair a major river crossing that offered a breathtaking view of the Cuyahoga River—through holes in the bridge deck.

We came to understand each other better from the state task force sessions. We learned how each level functions to move projects from agreement on a problem to implementation of the solution; we learned about the local process, the state process, and the federal process. We were appalled at how the process can work at cross-purposes and at the cost of delay. We found how much we had to learn if the situation was to be improved.

We all know the problems. Tinkering with the present programming process isn't enough, and understanding how the process is supposed to work won't solve the problem. Even if we operate our existing programming system as quickly and efficiently as possible, it won't even keep up with the crisis. We must make major changes in the whole programming system. An answer that does not reassess the whole process step by step and try new methods and practices is a waste of time. The old ways will not work in today's economic environment. We must reconstruct the programming business, not just rehabilitate it, if this nation's highway system is to survive.

Change is difficult, especially for engineers and others who strive for a certain order, precision and hard numbers. I do not advocate change lightly. From a political viewpoint, changes make great campaign rhetoric but can be lethal for elected leaders who must implement them.

But change is what the eighties are all about. We must reexamine the whole programming process and make it responsive and useful in economic terms. We built up a multi-layered approach based on years of revisions in law and regulations. This layer cake needs to be dismantled and the essential pieces put together in a flexible, fast, and responsive approach. There is no time for an academic review of old habits. It is time to try innovative ways of answering some hard questions: Why must it take a year to get a consultant approved when the project is almost identical to others that consultant has designed successfully for years? Why do we hire a consultant on the basis of how well he can get the project through the state? Why are we selecting a consultant, not for technical superiority, but for his bureaucratic finesse? Are all those review steps necessary on all projects? Can a project go through review and stay small? Somehow they get bigger, take longer, and become more expensive.

Can we rely on federal funds to the extent that all our practices continue to be geared to federal standards? Why do projects that require no matching funds from the state get held up by the state? Why do the states move so slowly on projects that will save them money?

What control mechanism is there to take projects out of the pipeline when priorities change? After a certain

amount of investment in design and review, projects acquire legitimacy in their own right that may not be appropriate in the limited resource environment. Can we clean these out before they cost so much in dollars and effort that we can't afford to reconsider? What is the best way to decide which highway facilities to abandon? We can't afford to keep them all in safe condition.

Are we ready to involve the private sector as an equal partner? Can we attract private investment in projects that take will years to mature? Will the private sector tolerate the time frame built into our current programming practices? The private sector has always been involved in the political side of programming decisions. How can the private sector gear its financial money and economics to a long period delay?

Are there management and financial investment practices we should apply in programming? The electronic age allows transfer of millions of dollars in complex accounts every day—look at how the stock market operates. Yet we still seem to be dealing in letters with seven copies that take months to answer. By the time we have three or four meetings at the Department of Transportation to be reassured that the project will be sold when the funds are available, there may be a better solution. Foregoing federal or state funds and doing a small scale, locally funded repair may be an expensive way to do business. It doesn't help any of us, and there simply has to be a better way. Sometimes no is a better answer. We need to arrange a way for each participant to say no gracefully.

Part of the answer is more flexibility. Our most urgent priority is bridges, and we have bridge projects ready for sale and all the nonfederal funds lined up. Why can't we assign federal dollars to these most critical needs? With the reduction in federal dollars, we may have the opportunity to do the most important projects. Regardless of what particular category they are, this is progress.

In any case, it is questions like these that bring us to the conclusion that a major overhaul of the programming function is necessary.

Part of the answer is a fresh look at the whole programming process. What we need to do in the coming decade is to innovate, and we must change. We must learn from each other; we must not get so caught up in the technical language describing the process that we accept any part of the process at face value.

F. WORTH LANDERS

City of Worcester, Massachusetts

I would like to comment on a few of the topics suggested for consideration at this workshop.

MANAGEMENT ISSUES

1. Organizational Approach — My own feeling and, I have found, the consensus of other local public works officials, is that the basic approach established by the Federal Highway Administration is sound. It allows for a variety of local considerations, recognizes broader regional and state transportation problems, and provides the framework for a proper programming procedure.

A major concern, and frequent comment, of local public works officials is that the total process from project identification to award of contract is too lengthy. People in several Eastern states indicated that this process takes four to seven years. During this time, further street deterioration occurs, the inconvenience and cost to the traveling public is increased, and the cost of construction increases annually.

The specific organizational structure adopted in the different states is apparently varied in form, in effectiveness, and in the spirit with which it is carried out. The director of public works of a city in one state has said that he feels the local/state transportation planning program is working well. He feels that he has a good opportunity to identify project needs; that an equitable rating system has been developed for prioritizing projects; that there is good interchange during the programming process; and that the state representatives care about making the system work properly.

However, I have also heard complaints: "The Metropolitan Planning Organization has only met once since 1978" and "The TIP-MPO Systems do not really work—too much politics."

I feel that the MPO Process should be retained; otherwise, local input will be lessened.

2. Local Involvement — The local official is very concerned about highway construction and maintenance within his jurisdiction. A workable system is needed—one that will provide local input to the programming of major highway work within the municipal boundaries. The local public works manager has intimate knowledge of his highway system and its needs. When federal and state-financed improvements are completed, he frequently must maintain them—for a great many years. He looks for a fair opportunity to be involved in the state programming process. He is seeking a true partnership in a common task, rather than a grantor-grantee relationship.

3. Standards — Over the past several years I have heard city and public works officials across the country complain about the rigid application of standards that may not apply in a particular municipal circumstance. It is understood that standards are often necessary to ensure system compatibility, safety, and the quality of grant-funded construction. But technical judgments as to the application of standards to particular situations should be made by the responsible official (provided he is technically qualified) of the agency that must operate and maintain the facility and deal with related citizen suggestions and complaints. State and federal highway officials should not lightly supersede the judgment of a responsible licensed city or county engineer experienced in local street design.

FINANCIAL ISSUES

1. Revenue Shortfall — The financial plight of the nation's cities has become serious. To study the problem, the American Public Works Association Task Force was appointed in spring 1980, and I was privileged to be one of 17 members selected from across the United States and Canada. The task force assignment was completed in July 1981. It is the judgment of the task force that overcoming revenue shortfall is the most important challenge currently facing public works officials. Competition for limited funds, inflation, recent emphasis on expanding "human" programs, and the political focus on present rather than future problems has resulted in a disinvestment in the capital stock of many of the nation's cities.

This disinvestment has occurred largely through postponed capital maintenance and replacement. Since 1965, the percentage of the United States gross national product invested in public works has fallen from 3.6 percent to 1.7 percent—a 53 percent decline.

The pending municipal crisis resulting from deferred maintenance cannot be overemphasized. We are already feeling the effects of a decade or more of insufficient maintenance and replacement funding, and the backlog is growing geometrically in the face of inflation, declining revenues, and deteriorating capital stock. Like a pensioner gradually spending his life's savings, many of the nation's cities are living off their public capital and, little by little, exhausting it.

Deferred maintenance and replacement in my own city has resulted in substantial deterioration of water, sewer, sidewalk, and street systems. Over the past 25 years, Worcester's street system has deteriorated at a rate 40 percent greater than the rate of replacement and rehabilitation.

Worcester's present situation is becoming even more critical as a result of tax-limiting legislation that restricts municipal tax levies to 2½ percent of the municipal valuation. In Worcester, this means a reduction in actual tax levies from fiscal year 1981 over a five-year period at a rate of 15 percent a year. If no way is found around this dilemma, my public works department will, at the end of the five years, have a purchasing power of only 38 percent compared to fiscal year 1981.

The present and very real problems of revenue shortfall cannot help but color the relationships of local public works officials with other agencies, such as state highway and transportation departments.

2. Financial Management — There is a great deal of concern about the dichotomy between needs and funding. The Boston area planning region, for instance, has identified urban system and primary system needs five times greater than current funding availability. Similar needs exist in other urban areas. The local public works manager becomes particularly concerned with federal proposals to freeze or reduce funding for the urban and primary systems. Funding is desperately needed for preservation of major local highways; from the local point of view, cutbacks in federal highway funding for such programs could not possibly come at a more difficult time.

Due to local and state revenue shortfalls, it would seem that greater emphasis must be placed on preserving the existing system rather than on new construction. This has been my own experience and it has also been the experience of other local officials.

In summary, from this local viewpoint, some states seem to have effective highway programming systems; some need improvement. Local highway managers want to participate in their states' programming process, and their local knowledge may improve the end product.

Revenue shortfalls permit less new construction and require greater effort on system preservation. Simplifying some of the rules will help agencies adjust to the new realities of rehabilitation work and reduced staffing, and will improve project delivery times.

MARILYN SKOLNICK

League of Women Voters of Pennsylvania

Why should this workshop consider the role of citizen participation in highway programming? Perhaps the key lies in the definition of programming—the matching of available projects with available funds to accomplish the goals of a given period. The two terms "available projects" and "available funds" may be the keys.

Today, when there is an ongoing discussion about the "new federalism" and the return of more responsibility to state and local governments, accompanied by a decrease in funding, it becomes important to develop a constituency that will support programs requiring a large expenditure of limited dollars. In order to develop this supportive constituency, you will have to involve the public in your deliberations—as difficult as you might find this to be. At the risk of sounding too simple, the process of involvement must begin at the beginning. You are well aware of the keen

competition for precious dollars, and only when there is complete understanding of why programs are needed and a good case can be made for them will there be any public support.

Of all the possible areas for the expenditure of public funds, highway programming is perhaps the most beleaguered. The past comes back to haunt transportation and highway departments. Think back to the time when funding was not a problem and the automobile was king. What happened? Highways were built everywhere with little or no concern for the social and economic consequences of their construction. Viable neighborhoods were decimated; families were uprooted and insufficiently compensated for the disruption of their lives; environmentally sensitive areas were destroyed; and, perhaps worst of all, highway building encouraged and reinforced a form of development that we have come to realize in the eighties is one that we as a nation can no longer afford—urban sprawl.

In desperation, citizens banded together and developed the "stop the highway" movement of the late 1960s and 1970s. This banding together led to the formation of citizen coalitions. The taste of victory was sweet. As a result of being left out of the decisionmaking process for so long, these citizens decided that the only way to make anyone listen was to control the funding. It is interesting to note that California, the freeway state, was the first state to feel the citizen backlash. Perhaps it was just a coincidence, but Proposition 13 was conceived there. No one knows what final effect this legislation will have on the state, but it is safe to say that the initial euphoria has now given way to apprehension. We will all be watching events as they unfold in California and in other states that have passed measures like Proposition 13—Massachusetts, Arizona, and Colorado. This is an example of citizen participation in the extreme. Citizens, these days, have become very sophisticated and know when they are being used and abused.

All transportation and highway departments should use the experience of the past and should budget adequately for public participation and involvement. The cost should be considered part of the cost of doing business.

But you say, "No one comes to meetings." Well, they won't come and participate if they:

- Are expected to attend a pro forma public hearing held at the end of a long period of internal involvement from which they have been excluded, and they are now expected to rubber stamp all decisions.
- Are asked to be part of an advisory committee or task force and their advice is never considered or is rejected without a valid reason.
- Are not given staff support and background material in a timely fashion and in language a nonprofessional can understand.
- Realize that their energy is being sapped in useless decisionmaking so that by the time important decisions have to be made, they are exhausted and will agree to anything just to get home.
- Perceive most of the appointees to be political hacks.

You will get cooperation on a regional, county, or local level if you:

- Vigorously advertise for volunteers, and really mean it. You should accept everyone who shows up and should not worry about large numbers. After the third meeting, when assignments are made, all who are not really interested will drop out and you will have a workable number.
- Clearly describe the group's function, as well as what will be expected of them. Do not let the group begin deliberations with expectations that can never be achieved.

- Allow the participants to set the time and place for the meetings. You should help set the agenda, provide supportive staff and, most importantly, provide out-of-pocket expenses if needed.
- Work out from the beginning a procedure for mitigating differences.

By including citizens in the decisionmaking process, you will not only develop a sympathetic constituency but also a grass roots knowledge of an area, all of which are essential to good programming.

In conclusion, I would like to quote from "Citizen Participation in the American Federal System," published by the Advisory Commission on Intergovernmental Relations. This publication sums the subject up nicely.

"A full and free interchange of information between the people and their elected representatives, as well as between the people and their appointed administrators, clearly is essential to responsible and well-informed public decisionmakers and responsive government. The decisionmakers need to know what the public wants and how the decisions they make work out in practice. For their part, citizens need to know what the officials are doing so that they can hold them responsible; the public must also know the reasons for governmental decisions if they are to retain confidence in the soundness and equity of those decisions."

LANCE A. NEUMANN
Cambridge Systematics, Inc.

and

JOSEPH DRESSER
Wisconsin Department of Transportation

Over the past few years, the rate of growth in revenues available for transportation at the state level has slowed considerably, and increasing gas prices, supply shortages, and federal fuel efficiency standards may result in an actual decrease in total revenues available for transportation in some states in the future. This slowdown in the growth of revenues, the impact of inflation on the construction industry, the increase in routine highway maintenance needs, and greater expenditures in other modes have resulted in a sharp decline in funds available for highway rehabilitation and improvement.

Wisconsin, like many other states, must make increasingly critical decisions on how to use scarce highway improvement dollars. While significant improvement to portions of the primary, secondary, and urban systems appears desirable, it is clear that the design standards reflected in earlier system plans and needs studies will not be met systemwide. Rehabilitation and resurfacing needs are increasing as the system ages, and a large number of bridges, particularly those with severe load-carrying limitations, are coming due for replacement or will face further restrictions on use. Uncompleted portions of the Interstate system are facing deadlines set by the 1978 Surface Transportation Act, and Interstate rehabilitation is becoming a critical area of concern.

To assist in analyzing this array of issues and investment choices, the Wisconsin Department of Transportation has developed and implemented a highway investment programming process over the past two years. The primary objective of the process is to provide top management with

a range of policy choices and an assessment of the transportation, economic, social, and environmental consequences of those choices. The improved programming process and a set of new technical support tools were used to develop an initial highway program covering the years 1980-1985. It is the department's intention to update this program every two years and to expand its scope to cover all modes.

OVERVIEW OF THE PROCESS AND RESULTS FOR THE 1980-1985 PERIOD

Traditional highway programming efforts in Wisconsin—and other states as well—have suffered from the use of need studies or system plans reflecting unrealistic revenue assumptions, an inability to weigh tradeoffs within and between program areas (e.g., bridge replacement versus highway rehabilitation or improvement), the lack of a systematic method for maximizing statewide versus local or project benefits, and a failure to consider a broad range of social, economic, and environmental impacts. Generally only one design alternative or potential investment level is considered for each project in programming, and projects are ranked either subjectively or by using a more technical method, such as a sufficiency rating, priority index, or benefit cost analysis. For the most part, only one program alternative is explicitly developed, and little formal program evaluation occurs. In short, program development has been viewed as a mechanical process of going down a priority list until available funds are exhausted.

To address these shortcomings, an improved programming process must meet several key requirements. It must:

- Provide a range of policy choices to top management, not simply one recommended program alternative
- Maximize system benefits over individual project benefits
- Consider alternative design concepts (i.e., investment levels) for each project
- Explicitly develop alternative improvement programs for evaluation
- Utilize a range of consistent evaluation criteria procedures to evaluate project and program options.

Since the most critical objective of the process was to improve the department's investment decisionmaking capability by providing management with fully evaluated policy choices, it was necessary to develop explicit alternative improvement programs. In turn, developing meaningful alternative programs required that project alternatives—that is, alternative levels of improvement for a given highway segment—also be made available. Under some program assumptions (e.g., constrained revenue), the appropriate level of improvement for a given segment might be a resurfacing or minor reconditioning; under other conditions (e.g., a revenue increase), more major improvements might be warranted. Unless this dynamic relationship between project level improvement scale and program alternatives is explicitly recognized, a key element of program choice is ignored, and program alternatives are simply different combinations of projects, each having only one proposed design.

It was recognized that in many cases, particularly for candidates for programming in the early years of the program period (1980-1981), project design options could be very constrained for any number of reasons. The results of the project development/EIS process, prior commitments to local units of government, and federal-aid eligibility requirements may narrow the range of viable design concepts. Nonetheless, in many cases, more than one feasible design concept was available, and a final choice would be influenced by state level program and policy directions.

To meet the requirement that systemwide or statewide benefits be maximized over project or local benefits meant

that consistent criteria had to be established to define deficiencies, develop design solutions, and select projects in all eight district offices of the department. The basic steps of the new programming process were:

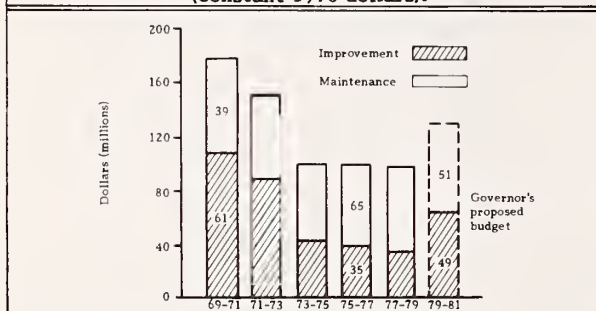
- Analysis of existing conditions and deficiencies
- Development of alternative programs
- Evaluation of alternative programs

The approach to each of these steps and selected results are described briefly below.

Analysis of Existing Conditions and Deficiencies

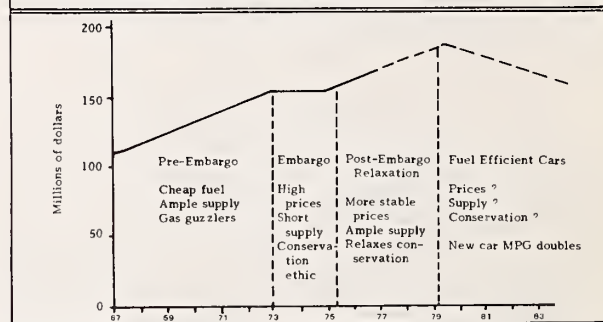
The first step in developing a multiyear program was to assess thoroughly the existing situation with respect to revenue availability and highway system physical and service conditions. As in many states, Wisconsin has seen a steady erosion in the buying power of the highway improvement program. In fact, during the ten-year period from 1967-1977, the buying power of state funds available for highway improvements has decreased by 75 percent, primarily because of inflation in the construction industry and increasing expenditures for routine maintenance (not including resurfacing) and nonhighway programs. Figure 1 shows the trend in expenditures on maintenance and improvement over the past few two-year periods. (The reversal in the trend toward decreasing highway improvement expenditures shown for the 1980-1981 biennium was the result of the department's most recent budget submittal based on the six-year program developed by this project. Over \$60 million in state general funds were approved for highway purposes.)

Figure 1. Decline in state improvement dollars—comparison of maintenance/construction (constant 1970 dollars).



Another factor that will reinforce the decrease in improvement funds in the future is an expected slowdown in the rate of growth of overall revenues. Figure 2 shows the trend in the state gas tax revenues over the past ten years. Gas tax revenues, which currently account for over 50 percent of total revenues, are expected to decrease in the future due to fuel price increases and improved fuel efficiency in the vehicle fleet. As a result of all these factors, it is expected that Wisconsin will not be able to match available federal aid in the mid-1980s.

Figure 2. Trend in gas tax revenues.



In parallel with the assessment of revenue availability, existing highway system physical and service conditions were analyzed. The assessment specifically avoided the needs study approach and defining deficiencies in terms of traditional highway standards. Instead it recognized that as a practical matter, definitions of need and deficiency vary from time to time based upon a number of factors, including public acceptability of existing conditions, cost of improvements, and revenue availability.

To provide some objective measures of roadway conditions, a set of deficiency data was collected for half of the system (about 6000 of the 11 900 miles). These data included surface age and pavement condition, accident rates and occurrences, volume-to-capacity ratios, percent no-passing zones, and other geometric and structural criteria. The deficiency data for each segment were placed in a computer file for efficient editing, sorting, analysis, and display.

Using the computer information system, a series of deficiency reports were produced, summarizing the extent and severity of various deficiencies statewide and by district, functional class, etc. Figure 3 illustrates the type of output developed from these reports. These reports were

Figure 3. Roadway cross section deficiency mileage.

The following mileage summary shows the number of reported miles that have substandard pavement and/or shoulder widths.

Functional Class	Total Miles	District Number								
		1	2	3	4	5	6	7	8	9
Principal arterial	967	147	70	124	106	134	84	159	135	8
Minor arterial	2,488	381	306	333	292	281	293	212	390	-
Major collector	1,228	271	98	104	113	181	131	232	98	-
Minor collector	38	14	4	5	-	-	15	-	-	-
Total	4,721	813	478	566	511	596	523	603	623	8
Accident Rate:		Threshold Values			Total Miles			Ave. Rate		
Sample ave. - 346		@ 300			1825			522		
Statewide ave. - 280		@ 500			602			770		
		@ 750			136			1193		
Accident Occurrence:		Threshold Values			Total Miles			Ave. Occurrence		
Sample ave. - 277		@ 300			756			778		
State ve. - 200		@ 500			275			1239		
		@ 750			131			1695		
Geometric: % passing:		Threshold Values			Total Miles			Ave. % Passing		
Sample ave. - 56%		@ 50%			1514			31		
State ave. - not avail		@ 30%			670			18		
		@ 20%			385			12		
Capacity: V/C		Threshold Values			Total Miles			Ave. V/C		
Sample ave - 0.40		@ 0.60			674			0.87		
State ave. - not avail.		@ 0.80			254			1.10		
		@ 1.00			99			1.37		

used to help guide the development of specific program alternatives and, subsequently, similar deficiency summaries were used as a means of evaluating program alternatives and summarizing program performance. The computer information system represented a crucial technical tool to support a process that must necessarily deal with a large amount of information and be capable of summarizing that information at different levels of detail depending on the issues of concern and the decisions to be made.

System conditions and deficiencies in other program areas were identified as well. For bridges, the results of the FHWA Sufficiency Rating Formula and the department's own priority listing based on load-carrying capacity, overall structural condition, and geometrics were used to assess replacement needs. The most recent Interstate cost estimate (1979) prepared for FHWA served as a basis for assessing potential improvements on that system.

Once the screening of deficiencies of the state highway system was completed, alternative improvement project concepts were developed for those segments judged most deficient. In identifying potential improvement projects, emphasis was placed on those segments requiring surface renewal in the six-year period, coupled with safety, geometric, and capacity deficiencies. The minimum improvement alternative proposed for each segment was expected to be a resurfacing project or a resurfacing project coupled with the minimum structural renewal necessary to support a new surface. Depending on the severity of the deficiencies present, higher levels of improvement proposed for a given segment varied from minor reconditioning projects to major reconditioning, reconstruction, and major projects on new alignments.

Again, the purpose of developing alternative improvement concepts for a given segment was to allow the improvement level to vary depending on the program parameters assumed (e.g., overall revenue level, allocation of revenue by district, subprogram emphasis, etc.). For each alternative improvement concept for each segment, data on the key design elements, potential impacts, cost estimates, and schedule were collected and placed in a computer file, which could be cross-referenced with the deficiency data file to produce summaries of the deficiencies addressed by different sets of projects and programs.

For about 30 major project sites, a range of alternatives was identified, based primarily on current or past studies. These 30 projects were subjected to formal benefit-cost analysis using the Highway Investment Analysis Package (HIAP) developed for FHWA. The use of benefit-cost analysis, while recognized as only one of many factors affecting major project decisions, did point out the tradeoffs involved in successively increasing investments in one or a few project sites versus funding more moderate improvements at more sites. In addition, the testing of a range of alternatives at each site often identified other potentially cost-effective alternatives that should be developed and analyzed.

Development of Alternative Programs

Based on the analysis of deficiencies, it was clear that a range of key policy issues had to be explored in developing alternative programs. These issues included:

- The benefits available from a revenue increase under varying assumptions about how additional revenues might be spent
- The benefits of greater emphasis on safety or capacity improvements versus pavement preservation
- The most cost-effective mix of resurfacing and reconditioning work for maintaining some minimum pavement quality
- The tradeoff of funding a relatively few major improvements versus many more small improvements

Given the expected trend in gas tax revenues, the needs to explore the potential for a revenue increase and to demonstrate how additional revenues could be used were identified as the most critical for the department.

While the number of alternative programs that could be developed and evaluated was limited, a range of reasonable funding levels was defined for each of four program areas: resurface, reconstruction and recondition (RRR); bridges; the Interstate; and major projects.

Figure 4 shows the funding levels selected for each area. The funding levels selected for each of the program areas were based on the results of the deficiency analyses described earlier, expected federal funding availability, previous program commitments, and the policy preferences of top management. The objective was to identify the likely range of expenditures by program area, assuming different total revenue levels and policy directions. Thus, for the general RRR program area, expenditures of at least \$200 million (1978 dollars) were estimated to be necessary during the 1980-1985 period simply to meet surface renewal objectives. On the other hand, even under the most optimistic revenue scenario (i.e., assuming a major revenue increase), coupled with minimum expenditure levels in the other program areas, it was unlikely that RRR program expenditures would exceed \$400 million.

As shown in Figure 4, three program funding levels were selected for each of the RRR, bridge, and Interstate areas. The major projects were grouped into categories identified as committed (e.g., essentially under construction), and high, medium, and low priority candidates without explicit program levels set.

Figure 4. Structure of program alternatives.

Program Area	Alternative Program Levels (millions of 1978 dollars)		
	Low	Mid	High
Resurface, recondition, reconstruction	200	300	400
Interstate	90	135-195	245
Bridge replacement	70	100	140
Major projects	120	listing of additional projects	

The development of alternative programs for the RRR area was guided by guidelines which identified surface renewal mileage targets and other priority criteria as well as overall funding levels. While district offices were given initial funding targets, it was made clear that final district funding levels would depend on a statewide evaluation of initial district submittals and the desire to develop a consistent program district to district. Figure 5 illustrates the criteria that were expected to be used in determining the appropriate level of improvement. However, overall funding level as well as deficiency criteria had to be used together in making project selection. At the lowest funding level for the RRR program area (\$200 million), district choices were constrained by the surface renewal target, and the majority of projects were for resurfacing and minor reconditioning. However, at higher funding levels, there was increasing flexibility to fund major reconditioning and reconstruction projects while still meeting surface renewal goals. Figure 6 illustrates the relationship between project and program alternatives. Figure 7 summarizes the types of improve-

Figure 5. Improvement level threshold deficiency requirements.

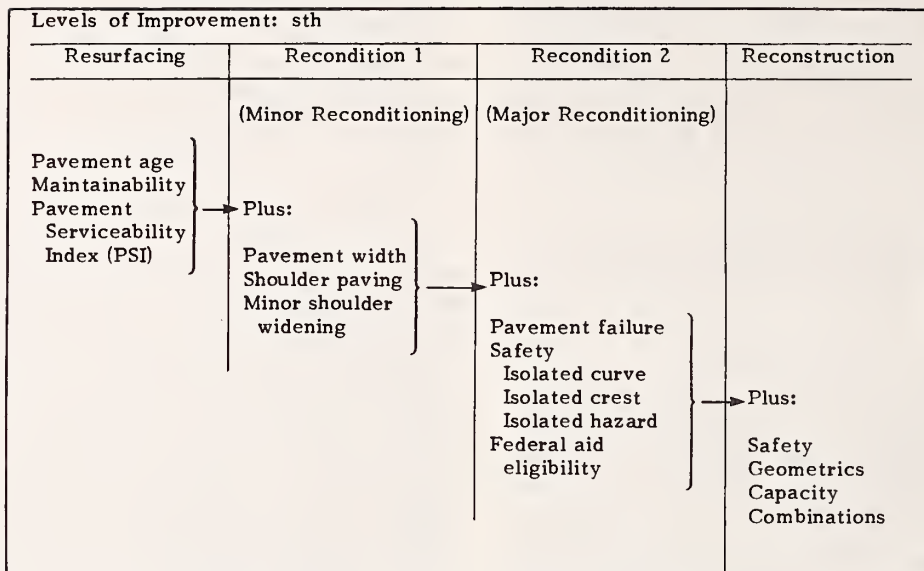


Figure 6. Relationship between project and program alternatives.

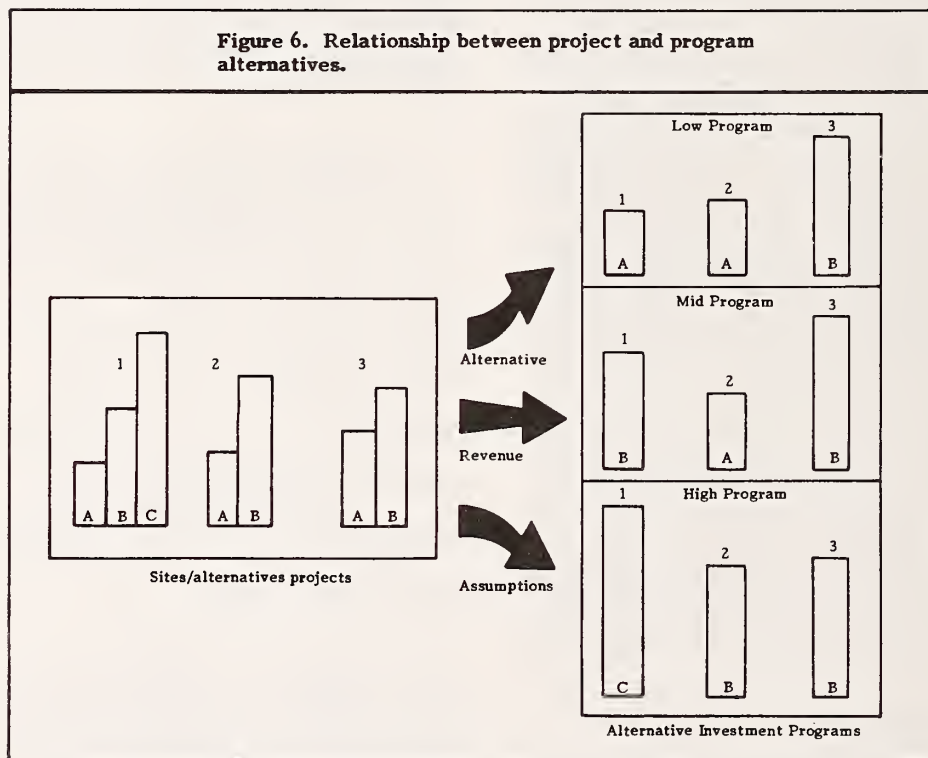


Figure 7. Summary of program alternatives—RRR program area.

Resurface Recondition, Reconstruction Program	Totals		Resurfacing		Minor Reconditioning		Major Reconditioning		Reconstruction	
	Cost	Miles	Cost	Miles	Cost	Miles	Cost	Miles	Cost	Miles
Low	202	3165	112	2415	24	282	44	397	22	71
Mid	300	3387	100	2024	30	337	84	682	86	244
High	404	3679	99	2013	35	378	112	558	158	372

Costs in millions of 1978 dollars.

ments funded by the RRR program alternatives. Additional resources above the \$200 million level increase total mileage somewhat but dramatically increase expenditures in the high improvement categories.

Some consideration was given to specifying relatively rigid rules or priority thresholds (e.g., accident rate above a specified level, etc.) for projects proposed for higher level improvements. However, subject to meeting surface renewal goals, districts were given wide latitude to set priorities. This was a more prudent approach initially, given variations in conditions district to district and a lack of agreement on the acceptable range for any threshold criteria. More defensible threshold criteria could be set in future cycles depending on the degree of variation occurring in initial district submittals.

The development of alternative bridge, Interstate, and major programs also was guided by an explicit set of priority and policy guidelines, but here too the use of a strict formula was avoided. For bridges, primary consideration was given to load-carrying capacity and posted limits, overall structural conditions, geometrics, age, and traffic levels. For Interstate improvements, priority was given to completion of the system and selected operational and safety improvements on existing facilities. For selected major improvement projects, benefit-cost analysis was performed as one input to priority setting, and projects were grouped in several priority categories depending on whether work had been initiated or strong commitments implied and the extent and severity of deficiencies.

Evaluation of Alternative Programs

Once alternative programs had been developed, program evaluation focused on four issues:

- Description of the contents of each program alternative (e.g., miles of improvement by type, etc.) and the extent to which guidelines were met (e.g., surface renewal targets and funding levels, etc.)
- Consistency of program submittals from district to district in terms of the deficiencies addressed, level of improvements proposed for given deficiencies, cost per mile by improvement type, etc.
- Benefits of each alternative in terms of prolonged surface life, accident reductions, capacity improvements, etc.
- Potential economic, social, and environmental impacts

The evaluation relied heavily on the deficiency data produced earlier in the study. The extent and severity of

deficiencies on segments selected for improvement were reviewed, and the improvement level was specified, based on a certain set of deficiency characteristics. Again, without a well-organized information system that could efficiently match deficiency characteristics with project summary data, extensive evaluation would not have been possible. Manual methods of estimating the potential accident reductions and capacity benefits from each program were developed to augment the information obtained from deficiency files and formal benefit-cost studies. The potential economic, environmental, and social impacts of the alternative programs considered have been estimated to meet the spirit of state environmental law and recent regulations of the U.S. Council on Environmental Quality. The environmental assessment was done by analyzing the specific impacts of the larger improvement projects and performing a generic assessment of the likely impacts from several classes of lower cost projects. Figure 8 shows selected results of this analysis for the major project area.

The availability of program alternatives was instrumental in displaying the likely impacts of varying funding levels in each area and allowed an explicit consideration of the tradeoffs within and between each area. Figure 9 summarizes the basic elements included in the alternatives for each program area and provides some indication of the tradeoffs available by shifting funds from area to area. More detailed descriptions of these tradeoffs were used to guide the selection of the proposed six-year program and to document and justify the choices based on the alternatives considered.

A recommended program was developed based on an assumption that a major revenue increase would not be sought. Subsequently, a change in state administrations required a recycling of the program development/evaluation activity to produce a recommended program based on a substantial revenue increase. The availability of all the key data in the deficiency and project summary files allowed this substantial modification to the program to be completed within a few weeks. The evaluation again focused on the same basic issues and the results provided the necessary background material to the legislature for its budget deliberations.

The legislature subsequently passed a biennial budget for 1980-1981 which provided over \$60 million in general funds to supplement the transportation fund. During the current biennium, the department must recommend a permanent funding mechanism to generate additional funds of roughly this magnitude for the transportation fund. The department's recommendations on the relative emphasis between program areas and on specific projects were adopted without any substantial changes.

Figure 8. Summary of social, economic, and environmental impacts of major project program options¹ (1980-1985).

Social, Economic, and Environmental Impacts	Low Program (\$160M)	Approved Program (\$260M)	Recommended ⁴ Program (\$360M)	High ⁵ Program (\$410M)
Number of construction jobs generated (person-yrs., 1980-85)	4 500-4 800	7 300-7 800	10 100-10 800	11 500-12 300
Income generated statewide (millions)	\$240-430	\$390-780	\$540-1 090	\$615-1 230
Number of businesses displaced	8	12	25-65	35-89
Improvement in accessibility ²	101	379	473-752	543-926
Households displaced	45	87	104-217	133-288
Neighborhoods severed	0	0	1-2	1-3
Farm land required (acres)	1 468	1 508	2 033-3 433	2 383-4 308
Farms severed	53	54	68-109	78-134
Wetland filled (acres)	10	56	76-235	116-334
Habitat required (acres)	363	673	\$61-1 495	1 019-1 891
Added tons of salt per year	3 168	4 350	5 144-5 320	5 552-5 952
Infringement on endangered species	0	0	0-0	0-0

Figure 8, continued

Social, Economic, and Environmental Impacts	Low Program (\$160M)	Approved Program (\$260M)	Recommended ⁴ Program (\$360M)	High ⁵ Program (\$410M)
Infringement on unique areas total	0	1	3-9	5-13
Historical archeologic sites	0	0	1-3	1-4
Coastal zone management areas	1	1	1-1	1-1
Air quality				
Number of new pollution sources (projects on new location)	4	4	5-9	6-12
Projects on existing location				
Increase CO concentration	1	2	2-2	2-2
Decrease CO concentration	1	1	2-4	2-5
No change CO concentration	1	5	5-6	5-7
Noise levels				
Number of new pollution sources (projects on new location)	4	4	5-9	6-12
Projects on existing location				
Exceed present levels by 10dBa	2	5	7-8	7-9
Exceed federal design year noise criteria	1	9	2-3	2-4
Energy consumption ⁶ (BTU x 10 ¹²)				
Materials and construction	3.44-5.11	5.59-8.29	7.04-11.4	7.95-12.9
Vehicle consumption	n.a.	n.a.	n.a.	n.a.
Public acceptability of improvements				
No controversy	1	2	2-4	3-5
Low controversy	4	8	9-13	10-15
High controversy	3	3	4-7	5-8
Number of projects by WEPA class ³				
Type I	6	11	13-21	15-25
Type II	1	2	2-2	2-3
Type III	1	0	0	0

1 Impacts other than construction jobs and income generated do not include I-43 and George's Corners to USH 16.

2 In units of thousands of peak-period vehicle-hours reduced per year.

3 Under the Wisconsin Environmental Policy Act (WEPA):
 Type I projects are likely to have a significant impact on human environment.
 Type II projects may have a significant impact on human environment.
 Type III projects do not have a significant impact on human environment.

4 Impacts on the recommended program equal those of the approved plus \$100 million worth of candidates, may range from 3 to 11 projects depending on their cost.

5 Impacts of the high program equal those of the approved plus \$150 million worth of candidates which may range from 5 to 16 projects depending on their cost.

6 Does not include the two major bridges, Dubuque and Arrowhead.
 n.a.—not available.

Figure 9. Summary of program options—6 years (millions of 1978 dollars).

Program Level	STH Program Area		Interstate ¹		Bridge ²		Major ³	
	Program ⁴ Level	Key Program Elements	Program ⁴ Level	Key Program Elements	Program ⁴ Level	Key Program Elements	Program ⁴ Level	Key Program Elements
Low	\$200	surface renewal of 3 165 miles does not meet target of 3 400 miles or federal aid eligibility lost some minor structural and safety reconditioning and reconstruction work	\$ 90	work toward completion of I-43 high priority safety projects including median barriers (I-94) rest area (I-43) selected bridge deck overlays to preserve existing system freeway surveillance system in Milwaukee	\$ 67	replaces 150 bridges two-thirds of all posted bridges (34 of 49) selected low-load capacity bridges selected poor structural condition bridges	\$120	work toward completion of a committed major project costing approx. \$70 million begin work on three high-cost projects
Mid	\$300	surface renewal target essentially met (3 387 miles of 3 400 miles) and federal aid eligibility achieved significant expansion of improvement level over low level with some increase in the total mileage programmed	\$135 195	all elements of Low Program third lane projects on I-90, I-94 selected park-ride, rest area, bridge fencing removal of roadside obstacles, lighting	\$103	replaces 239 bridges includes all bridges in Low Program most remaining low-load capacity bridges all other poor structural condition bridges	Above \$120	work toward completion of nine committed major projects costing approx. \$70 million begin work on three high-cost projects additional major projects
High	\$400	surface renewal target exceeded (3 679 miles of 3 400 miles) and federal aid eligibility achieved further expansion of improvement levels with some increase in total mileage programmed	\$245	all elements of Mid Program selected interchange improvements I-94, I-794 noise abatement truck weigh stations, additional park-ride lots and expansion of lighting	\$143	replaces 311 bridges includes all bridges in Mid Program selected functionally obsolete bridges narrow roadway, restricted clearance, poor alignment selected marginal structural condition bridges likely to deteriorate in two-year period		

1 Does not include Interstate-3R Program.

2 Does not include several high-cost bridges requiring special funding.

3 Completion of committed majors estimated to cost \$70 million. Construction of other higher priority major projects estimated to cost from \$15 to \$125 depending on funding availability.

4 Figures in millions of 1978 dollars.

CONCLUSIONS

There are several important conclusions that can be drawn from this project:

1. A multiyear program, even in an era of constantly changing project development schedules and costs, funding levels and categories, and other factors, can be an extremely useful management tool. However, given the increasingly complex environment within which program decisions must be made, both alternative project design concepts for a given highway segment and alternative programs must be explicitly considered to explore important policy choices. Simply setting priorities among a list of projects for which only one design concept is proposed is often overly simplistic and ignores a key dimension of program choice.

2. To store, edit, and analyze the data necessary to develop and evaluate a range of program alternatives requires a well-designed computer information system capability and a range of evaluation support tools, both manual and computer assisted. On an ongoing basis, similar capabilities will be needed to monitor and update the program in light of project schedule and cost increases, new funding constraints, and changes in management policies and priorities. Developing this ongoing capability is the final element of the Wisconsin programming project.

3. A range of evaluation and priority criteria should be used to select project and improvements levels. While benefit-cost analysis and other technical criteria can be useful, rigid formula approaches lack the flexibility required to make final project selections in most cases where subjective and nonquantifiable factors must be considered.

4. On an ongoing basis, longer range system planning efforts and detailed project development activities must be closely coordinated with the program development function. Much of the information on system conditions, surface renewal needs, etc., can routinely be the product of a periodic system planning report. Similarly, information on project alternatives and impacts is routinely collected during project development studies. In addition, close coordination is needed to maintain alternatives for a given project as appropriate and to monitor project cost and schedule changes. While a stable multiyear schedule of projects is a desirable goal, program modifications will always be necessary, and the programming function should be used to identify and analyze the uncertainties and risks inherent in any proposed program.

5. Program level environmental analysis can be done and provides useful information in formulating proposed programs. Obviously, the level of detail of program level analysis cannot and should not approach that of a project EIS. Also the processing and administrative requirements of any formal program environmental report must be tailored to allow annual or biennial budget decisions to be made and program implementation to proceed smoothly. Nonetheless, CEQ regulations suggest that program level environmental analysis is required and, based on the Wisconsin experience, it is accomplishable.

Several areas for further research and development are apparent:

1. The tradeoff between highway and bridge maintenance versus improvement and replacement needs to be more thoroughly explored. Additional methods are needed to characterize program benefits and performance to allow a more systematic consideration of the tradeoffs implied by different programs. While a start was made on estimating environmental impacts, improved methods are required

2. Future cycles of the programming process should incorporate all modes of transportation in which the state is involved. Again, expansion to other modes will require the development explicit evaluation criteria and methods so that again program tradeoffs can be explored.

W. M. HILLIARD
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State of Florida

The programming activity in Florida is now done in the Division of Administration. In this same group are the Comptrollers Office, the Data Processing Office, and the Programming and Budget Office. All the financial activities were grouped into one unit to coordinate activities more effectively. In the past, programming was part of the planning function, and the main focus was on developing an interface between planning and programming. Information now flows from programming to planning, which pulls the two functions together and gives a different perspective on the kinds of plans that are being developed. We are no longer surprised to find that projects that have been planned for years are just not possible, are too expensive, or are environmentally unsound.

Florida tends to be result oriented; that is, we concentrate on contract lettings. After we let a contract, there is another two or three years before the facility is actually finished, but we are essentially through with that product and can move on to something else. Programming is the place where many factors of the decision process intersect—the financial revenue forecasting, politics, federal aid (cuts and opportunities), priorities, and cash flow. Unfortunately, a lot of the criticism also seems to fall there.

Florida has a technical programming process that works. The process is complex, but it really works. A major reason that it works is that we are in a full cash flow environment in Florida and we have a good system for cash flow management.

The concept of cash flow management is well recognized and understood by accountants and finance people, but it is not as well understood by legislators, government administrators, and the general public. And there are significant variations in the ways in which cash is managed between government and the private sector, between the federal government and the state, and among agencies within the state.

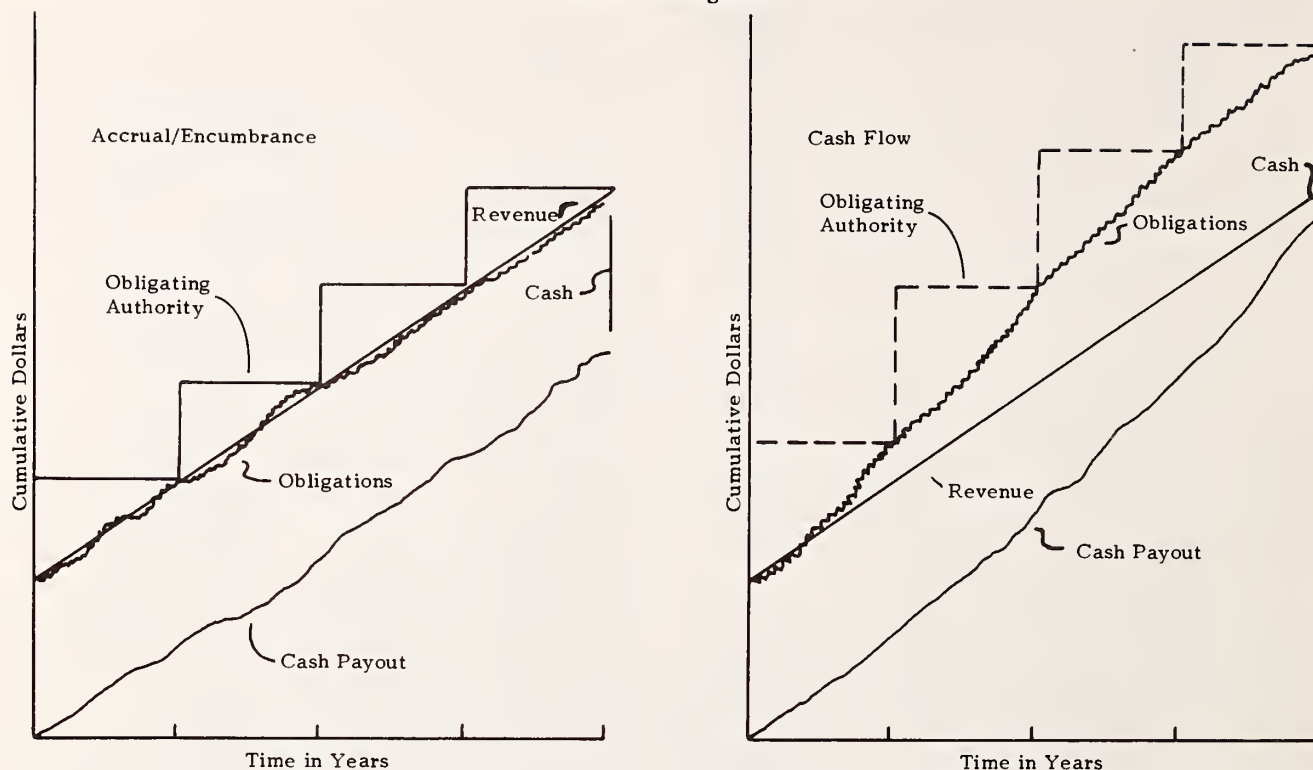
Figure 1 illustrates the concept of cash flow management by depicting the relationship between cumulative dollars and time for both accrual/encumbrance financial management and cash flow management. These charts show the different relationships between four variables:

- Obligating authority—assumed to be granted on an annual basis in blocks to the agency as a result of state appropriations, release of apportionment by the federal government, or other acts giving the agency authority to enter into contracts
- Revenue—actual receipt of funds
- Obligations—actual contractual commitments or initiation of work that will result in eventual expenditures and which follow a variable pattern generally limited by the obligating authority for each year
- Cash Payout—the actual flow of dollars

In accrual/encumbrance management, obligations at any point in time are approximately equal to the accrued revenue on hand. When this is the case, cash payment will lag behind obligations for a time period that generally equals the average payout time for all commitments. Assuming the average contract represented by the obligations in this chart required two years to completely pay out, the average lag time between obligation and cash payout will be two years. Thus, the cash on hand at any time as represented by the vertical difference between obligations and cash payout will approximate two years of revenue.

In cash flow management, obligating authority has been increased over that assumed in the accrual/encumbrance model. Obligating limitations have, in effect, been removed and replaced by an obligation plan which, when followed, will increase cash payout to some specified level.

Figure 1. Comparison of actual/encumbrance and cash flow financial management.



The difference between these two management techniques is that, under cash flow, obligations are limited only by revenue and the amount of cash necessary to make payments on the obligations. By design, obligations must be limited in such a manner that future cash payout never exceeds available revenue at any point.

In Florida, we have an \$800 million budget being paid out, and sometimes there is less than \$10 million in the bank from month to month. We have been able to operate like this over the past several years without going in the red. We have had to do some short-term borrowing (up to \$30 million) from the general funds, but we have been able to pay it back.

It is obvious that in the process of going from accrual/encumbrance finance management to cash flow management, additional obligations must be made and additional cash must be paid out.

Equating this to transportation financial management and assuming that cash on hand is equal to approximately two years revenue, then two years of additional contract lettings can be accomplished with the same revenue. The requirements for increased payout can be obtained from cash previously on hand awaiting payout.

In going from accrual/encumbrance management to cash flow management, the point of control is shifted from accrued revenue on hand to projected cash on hand at some point in time. This involves a change in accounting techniques and a change in the control parameters from known and reliable quantities (revenue on hand at any time, current cash balance, etc.) to forecasts of expected values of parameters in the future (projected revenue projected cash balance). The timeframe for critical control has also shifted from the present to some point in the future when the critical cash flow occurs. It is this change from known and reliable control parameters to unknown, variable, projected values for those parameters that causes the greatest concern to financial managers. Financial control has shifted from a static situation to one that is dynamic and less predictable.

Why, then, consider changing to such a process? What are its advantages?

The principal advantage is the increase in product output that occurs without the necessity for introducing new revenue. Thus, shifting from accrual/encumbrance to cash flow can be regarded as a one-time source of new revenue. It can also be argued that cash flow makes better use of available funds by providing a better return than the interest gained by investing liquidated funds. However, the financial advantage of a few points difference between inflation and interest earned is minor when compared to the advantage to the taxpayer in the form of transportation benefit. Transportation improvements are justified when the benefits are greater than the costs, including the opportunity cost of foregoing alternate uses of the money. If the alternatives are to either put the money in the bank at interest or to construct a transportation project, the state has no economic justification for taking the taxpayers' money for a transportation improvement until such time as the state is prepared to offer benefits in return; in other words, until the state is ready to actually build the project. The cash flow method offers the shortest possible time between the collection of taxes and the production of benefits.

There is also a question of who earns the interest. In many states, the unliquidated cash from transportation trust funds is invested with the interest accruing to the state general fund for the benefit of programs other than transportation. As an example, the state of Georgia recently passed legislation that permitted the interest earned from the investments of state highway trust fund monies to accrue to transportation programs. Because the trust funds have a significant amount of cash on deposit, this is expected to produce a major new source of transportation funds in Georgia.

In many states, the cash awaiting payout is used to support other programs on a cash flow basis. In other words, the state treasury may be on a full cash flow basis, although individual agencies such as transportation may be on the

accrual/encumbrance basis. In these cases, it would be impossible for all agencies to go on a full cash flow without introducing additional revenues.

HOW DO YOU CASH FLOW?

Basically, the activities associated with cash flow management relate to the four parameters, which must be forecast and monitored.

- **Obligating Authority**—Under cash flow management, obligating authority is theoretically unconstrained except by the impact which obligations will have on cash flow. In effect, the obligating authority targets developed under accrual/encumbrance management are replaced by targets derived from projected cash flow on planned obligations.
- **Obligations**—Obligations under cash flow management must follow some previously adopted obligating authority plan. This plan may be more critical under cash flow than under accrual/encumbrance because the timing and financial mix (state versus federal or other funds) of obligations must be consistent with cash flow objectives.
- **Forecasting Revenues**—The forecasting of revenues has become more difficult in recent years because of the volatility associated with gasoline supply and pricing. Where other sources such as license funds are involved, revenues may be erratic and difficult to forecast. Regression analysis and other forecasting techniques are usually employed for estimating this parameter. Cash flow management is best accomplished when revenues are stable and do not fluctuate significantly. When revenues are non-uniform throughout the year, choices must be made between carrying sufficient cash to manage through the low points in revenue, short-term borrowing to stabilize revenue, or program manipulation to match expenditure patterns against revenue. The manipulation of the work program may preclude taking advantage of "grab bag" opportunities and introduce inefficiencies and higher costs in the program implementation process.
- **Estimating Cash Payout**—Accurate estimating of cash requirements requires reliable and stable commitment plans from which appropriate payout curves can be developed for each type of commitment. Since, in transportation, states are normally concerned with thousands or even tens of thousands of individual commitments, an automated process is essential. Even when fairly reliable payout models are developed for each type of commitment, the aggregate payout of all commitments can be affected by variables such as weather, the amount of work which contractors in the industry have in force, economic events affecting the supply of materials, strikes, work stoppages, new federal requirements, etc. Once appropriate models for forecasting revenues and cash payout are operational, a system of tracking and reporting to management must be developed. The reporting must be simple, preferably graphical, and designed in such a way that decisions requiring action to speed up or slow down commitments and, ultimately, cash flow are easily obtained. Objectives for cash flow management must be set. Because cash flow management is dynamic and subject to constant change, a margin for error should be provided. This can be in the form of minimum cash balances, "staging" in federal aid programs (no longer permitted), reserve funds, advances from other funds, bonding authority, or other recovery devices.

WHAT ARE THE CONSTRAINTS TO CASH FLOW MANAGEMENT?

While a cash flow system has definite advantages, many states and agencies within the state are prevented by law from managing on a cash basis. Laws relating to financial management and accounting are sometimes old, oriented toward accrual/encumbrance management, and inappropriate for modern cash flow management. Updating these laws to permit a change in the financial management philosophy may be a greater task than cash flow management itself because:

1. Legislators are oriented toward the annual appropriation-type budgets which are accrual/encumbrance oriented.
2. Cash flow management reduces the prerogatives available for impacting future programs (the major part of annual appropriations may be required to pay bills for commitments made in prior years).
3. There may be a popular belief that cash flow management is akin to deficit financing.
4. Extreme cash flow management may generate temporary crises that leave a perception of mismanagement.

The management of any fund on a cash flow basis requires a certain amount of flexibility. This flexibility, at least to state transportation agencies, is only available in state gasoline tax funds. Federal aid comes to the states on a reimbursement basis for work already done and paid for and is controlled at the federal level on the accrual/encumbrance basis. Yet, the federal aid program is a significant problem in cash flow management because the state matching share must be available when required to match the federal share when payments to contractors are made. Payments to contractors are usually made from state funds with reimbursement from the federal government at a subsequent time. Although regularly apportioned federal funds are somewhat predictable except during periods where new transportation acts are under development, the discretionary and "grab bag" nature of some federal programs cause financial management under cash flow to be extremely dynamic with significant changes to the plan occurring almost on a daily basis. Even state gasoline tax funds are subject to state categories and other constraints that may prevent cash flow management or at least make it more difficult. As an example, in Florida, each of the 67 counties receives two cents of the 8 cents gas tax, which is put into an account for each county. Although some counties are on a cash flow basis and maintain minimum cash balances, others are not and the result is that there is always in excess of \$100M on deposit in the sum total of the 67 accounts. Pooling of the funds for use of the available cash is restricted by law.

SUMMARY

Cash flow management represents an alternative to transportation agencies to obtain more product without introducing new revenues and an opportunity to make better utilization of transportation trust funds.

Cash flow management involves risk, particularly in the transportation sector which is dependent on worldwide oil policy. Cash flow management also requires an entirely different management philosophy and management technology from accrual/encumbrance management. There are legal and political barriers to cash flow management. The decision as whether to embark upon cash flow management from an accrual/encumbrance is one which will be unique for each government agency and should only be done after careful review of the advantages, disadvantages, constraints, and resources required. It is, however, an alternative that should be explored in order to get the most from the tax dollar.

LEE H. BOWSER

Director for Program Development and Management
Pennsylvania Department of Transportation

In an era of severely limited resources, top level management must be intimately involved in the programming process. To be effective, in a management sense, the programming, budgeting, and authorization process must be closely integrated. This becomes even more critical as the nation shifts from new highway construction to transportation system management.

In a bold organizational restructuring, the Pennsylvania Department of Transportation shifted from its traditional allocation approach of transportation programming to an integrated, organizational approach. This restructuring was accompanied by a parallel realignment of fiscal and systems management functions. Program priorities and key programmatic decisions are now made through the Program Management Committee chaired by the secretary and composed of the department's nine top managers. Programs are developed by the newly created Center for Program Development and Management, which develops and presents options to the Program Management Committee. Fiscal implications are analyzed by the Center for Fiscal and Systems Management. The entire process is monitored and managed through computerized management information systems maintained through the Center for Fiscal and Systems Management.

THE LEGAL FRAMEWORK FOR TRANSPORTATION PROGRAMMING

The Pennsylvania Department of Transportation does not work in isolation. It is an administrative arm of the governor's office. While reporting to the governor, the secretary also chairs the Pennsylvania Transportation Commission, serves on the Pennsylvania Turnpike Commission, and also serves in a variety of other capacities. The Pennsylvania Transportation Commission is a 15-member body that serves in an advisory capacity to the governor, the general assembly, and the secretary. The commission is composed of leadership members from the general assembly and of public members nominated by the governor and approved by the state senate. Organizationally, the department is divided into three administrative divisions (safety, local and area transportation, and highways) and two staff offices (planning and administration). Other special functions, such as the press secretary, the inspector general and the chief counsel, report directly to the secretary.

The Department of Transportation is required by the Administrative Code of the commonwealth to prepare and submit to the Pennsylvania Transportation Commission each even-numbered year its recommended program for the next 12 years. Each biennium, the department, taking into consideration the recommendations of the commission and other relevant information, is charged with reviewing, revising, adjusting, and extending the commonwealth's transportation program for an additional two years.

Under the Administrative Code, the Pennsylvania Transportation Commission is charged with determining which highways, rapid transit, railroad, omnibus, marine, airport and other transportation facilities and services should be constructed or reconstructed and the recommended order of priority. From time to time, the results of the commission's determination are to be certified to the governor, to the general assembly, and to the secretary of transportation for their consideration. In determining the recommended order of priority in which transportation facilities should be constructed or reconstructed, the Pennsylvania Transportation Commission takes into consideration the priorities established by the department in its recommended 12-year program; however, the commission is not bound by the department's program or its priorities.

The constitution of the Commonwealth of Pennsylvania requires the governor to submit to the general assembly

each year a capital budget for the ensuing fiscal year. The capital budget must set forth proposed expenditures to be financed from the proceeds of obligations of the commonwealth, its agencies, or authorities or from proceeds of operating funds. The governor is also required to submit a financial plan for not less than five years, projecting expenditures for capital projects specifically itemized by purpose and by a proposed source of funds.

The general assembly has the responsibility under the state's constitution to appropriate funds for all payments out of the state treasury. The constitution, likewise, requires the general assembly to adopt a capital budget each fiscal year. Each phase of any project defined as a capital project requires the specific authorization of the general assembly for the expenditure of state funds.

While not specified in detail in current statutes, the department is required to coordinate development of the 12-year program in cooperation with substate entities. In accordance with the department's action plan, metropolitan planning organizations, regional planning agencies, county planning agencies, and interested federal and state agencies, have the opportunity to participate in the development of the department's 12-year program and in the Pennsylvania Transportation Commission's activities.

The diversity of federal legal and regulatory requirements affects program development and management. Several are of particular significance. Federal-aid projects in urbanized areas (more than 50 000 in population) are to be based on a continuing, comprehensive transportation planning process carried on cooperatively by the state and local communities. No project may be constructed unless responsible public officials and their views are considered with respect to the corridor, location, and design of the project. Federal-aid projects on the designated urban system are to be initiated by appropriate local officials with the concurrence of the state.

THE TRADITIONAL ALLOCATION APPROACH TO PROGRAMMING

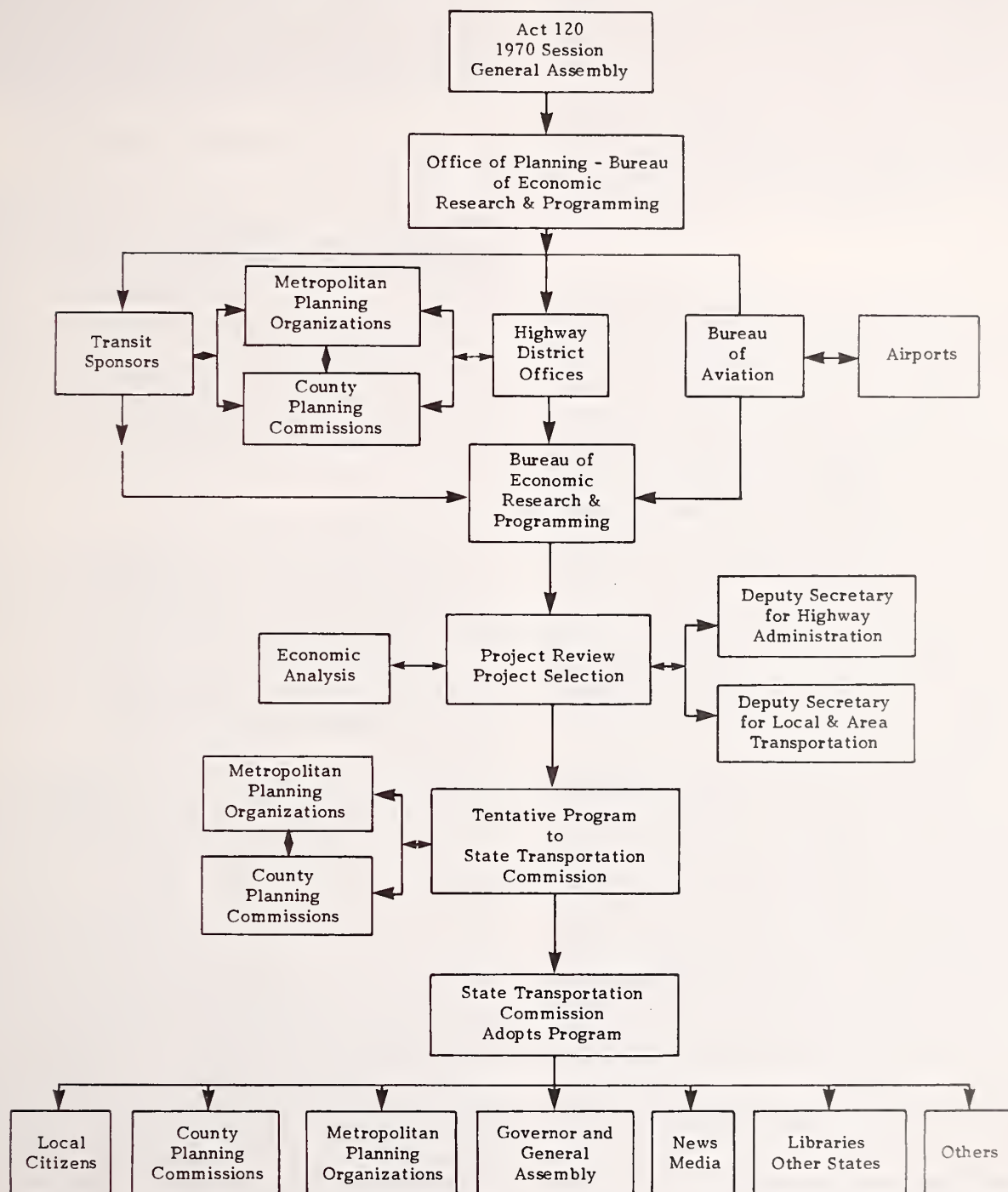
Pennsylvania's traditional approach to transportation programming was based on a county-by-county allocation of anticipated resources. These county-by-county allocations drove the capital program development process. Noncapital program development was scattered among various organizational units within the department. Other than the 12-year forecast of available federal-aid, there was an almost complete lack of financial planning. State funds were provided through bond financing.

Capital Program Development

Development of the department's capital improvement program was coordinated through the former Bureau of Economic Research and Programming (BERP). Even though capital program development was coordinated through BERP, decisions regarding priorities were, in general, external to the department. The prevailing process, driven by the county-by-county allocation formula adopted by the Pennsylvania Transportation Commission, followed the highly structured process shown in Figure 1. Anticipated financial resources were allocated to the commission's allocation formula. Within the 12-year county allocations, the department's engineering districts and county planning agencies assigned preferred priorities to individual projects. Prioritized projects were then selected for inclusion in the recommended program beginning with the highest priority and continuing until the respective county allocations were exhausted. The recommended program was subsequently presented to the Pennsylvania Transportation Commission, which ordinarily adopted the program as its own.

As long as resources were plentiful (or at least seemingly so, as with bond financing), this cooperative process ensured local input. However, inflation continued to take its toll, and revenues began to decline. At first, lack of current revenues for capital financing was offset by bond

Figure 1. Twelve-year transportation program: pre-1979.



financing. Eventually, all current resources were dedicated either to maintenance of the existing system or to debt service on previously issued bonds for capital improvements. As the commonwealth's ability to sell bonds expired, the 12-year programming process became "much ado about nothing." Finally, the process collapsed as the department's improvement program was placed on indefinite hold.

Noncapital Program Development

Noncapital programming was fragmented among various organizational units within the department. Categorical programs initiated during the sixties and seventies (such as

safety and highway restoration programs) were assigned to functional organization units. The nature of the organization was to institutionalize these assignments. Constituencies developed, leading to a very parochial process even within the department. This led to a variety of disjointed, narrow programs at the expense of the overall program structure. Inconsistent program structures tended to remain that way, in part, because the fragmented assignment of programming responsibilities either obscured or obstructed required changes.

The fragmented noncapital programs were less visible because of the relatively small dollar amounts involved with each when compared with the highly visible capital improve-

ment program. These less visible programs, while significant in cumulative expenditures and impacts, were completely overshadowed by the capital program. As the capital program became impossible to finance, it appeared that the department was doing nothing, even though it still collected more than 1 billion dollars from Pennsylvania taxpayers each year.

Because of the fragmented approach to programming, information available to management was often inconsistent and not readily comparable between programs. Decision-making tradeoffs required by increasingly scarce resources simply could not be made. This denied top management the opportunity to assess competing requirements in any meaningful way.

Financial Planning

The failure to integrate decisionmaking into the programming process contributed to the misunderstanding and confusion that existed both within as well as outside of the department. Further adding to the confusion was the lack of top management involvement in linking the budget process with programming.

In the early seventies, inflation notwithstanding, the department continued an ambitious program of highway construction financed largely through bond sales. Bond sales averaged \$250 million a year, reaching a high of \$440 million in 1976. By 1978, Pennsylvania's highway debt had increased to its current level of \$2.3 billion—twice as large as any other state in the nation. Bonds will not be fully retired until the year 2005, and through 1990, debt service will exceed \$190 million per year.

The near absence of financial planning during this period had several effects on programming. The financial constraints estimated for program development focused on total funds available during the 12-year period. Within the overall 12-year financial constraint, projects proceeded to implementation on a first-come, first-served basis. Shorter term, program-related financial issues were not addressed in any systematic fashion.

By 1977, the lack of integrated financial planning and program development led to a moratorium on construction. The commonwealth had exhausted its capacity to borrow money for highway construction, and it could no longer match federal-aid. Literally dozens of modern, multilane, divided highways had been started all over the commonwealth and were left partially completed—leading to nowhere, connecting to nothing.

The fragmented, allocation approach helps to explain the mentality that continued big-ticket construction (using bond financing) while the existing highway and bridge systems crumbled from age, weather, and overuse—the mentality that continued to rip-up basically good roadways in the name of safety and operational improvements while adjacent roadways lay riddled with unfilled potholes, and the mentality that continued to finance improvements with 100-percent state funds (bond financed) when, in fact, these same funds could have been highly leveraged with federal-aid.

Fragmented Programs and Fiscal Chaos

In summary, the traditional allocation approach to transportation programming failed to link sufficiently financial planning and management with program development and management. Pennsylvania's traditional concept of county-by-county resource allocation preempted the opportunity to address the commonwealth's highest priorities on a systematic, statewide basis. In this multi-centered approach to matching resources with projects, decisionmaking in the programming, budgeting, and authorization process was often misunderstood and confused.

Top management's involvement in decisionmaking had become mired in bureaucracy. There had become a fixation with process—especially with external coordination as a way of improving the process. This resulted in totally unrealistic

programs that diverted attention away from real problems and decisions.

To be effective in today's rapidly changing and highly uncertain world, top management needed the opportunity to control resources and to make basic decisions concerning program direction. Until this restructuring was achieved, top management found it difficult to have any confidence in the department's ability to deliver agreed-upon projects.

AN INTEGRATED ORGANIZATIONAL APPROACH TO PROGRAMMING

The new administration responded to unrealistic, fragmented programs and fiscal chaos by taking an integrated, organizational approach to programming. The first step was to develop a clear set of priorities as a framework for program development. Then, beginning with the legal framework established by the commonwealth's constitution and statutes, as well as applicable federal laws, the products of the programming process were defined. At the same time, an organizational framework was established to ensure top management control over program and fiscal matters. Out of this evolved the Center for Program Development and Management, which provided organizational structure and staff support for the integrated, organizational approach.

Priority Framework

The priority framework for program development shifted emphasis from new construction to restoration of the existing transportation system. While this policy pervaded the commonwealth's entire transportation program, initial efforts were focused on restructuring the highway program. The secretary of transportation established four groups of work activities:

First priority was given to routine maintenance, including general maintenance, maintenance and upgrading of equipment, traffic services, winter maintenance, and roadside services.

Second priority was given to improvements to the existing system, including restoration improvements on roads and bridges, bridge replacements and rehabilitation, and operational improvements. Road improvements were grouped into subprograms according to whether the restoration project was on the Interstate highway system, the non-Interstate federal-aid system, or whether the project was off the federal-aid system. Likewise, bridge projects were broken into subprograms according to whether they were on or off the federal-aid system. Operational improvements were subdivided into established safety improvements such as anti-skid and spot safety improvements (high hazard locations and roadside obstacles) and new initiatives to conserve energy, reduce congestion, and save lives.

The third priority was given to the highly leveraged federal-aid completion programs, including Interstate highway. Completions leveraged 9 to 1 for federal dollars versus state dollars, and the Appalachian Development Highway Program leveraged at 4 to 1 federal dollars against state dollars.

Finally, last priority was given to other federal-aid completions in the less leveraged primary, secondary, and urban systems programs. These programs only bring 3 federal dollars for each 1 state (or local) dollar. Of particular concern was the primary program, which was four times over-subscribed. For a decade, the commonwealth had been financing primary highway improvements with 100 percent state bond funds. Now, some three dozen primary highways remain to be completed at an estimated cost of \$3.7 billion (1980 dollars), and bond financing is no longer an option. Furthermore, the restoration requirements on the Interstate system exceed the federal-aid Interstate restoration apportionment to Pennsylvania by ten times. Emergency Interstate restoration work has had to be financed with federal-aid primary funds. Finally, the commonwealth's 10 000 miles of non-Interstate primary high-

ways require a minimum annual level of \$40 million in restoration work just to remain open to traffic.

Figure 2 shows how priorities were reflected in the commonwealth's restructured highway program. With these priorities and an overall strategy for dealing with federal-aid primary completion projects, the department proceeded to restructure its program development process.

Figure 2. Priority program groups.

-
- Group A— Routine maintenance (including general maintenance, maintenance and upgrading of equipment, traffic services, winter maintenance, and roadside services).
- Group B— Improvements to the existing highway system
- Restoration improvement on roads
 - Interstate restoration
 - Non-interstate federal-aid roads
 - Off federal-aid system roads
 - Restoration improvement of bridges
 - Federal-aid system bridges
 - Non-federal-aid system bridges
 - Bridge replacements and rehabilitation
 - Federal-aid system bridges (state and local)
 - Non-federal-aid system bridges
 - Operational and safety improvements
 - New initiatives to save lives and reduce congestion
 - Transportation systems management improvements
- Group C— Interstate and Appalachian system completions
- Group D— Other federal-aid completions
-

Organizational Framework

A Program Management Committee was established to take advantage of the collective background and experience of top management within the department. Committee members include the secretary of transportation as chairman, the department's five deputy secretaries (for planning, administration, highway administration, safety administration and local and area transportation), and the new directors of fiscal and systems management, program development and management, and communications.

Fiscal management and computerized information systems were pulled together into a Center for Fiscal and System Management. Budget priorities and the budget structure were revised to enable immediate production of a transportation product with very limited resources. The department's past bond financing approach was changed to cash financing. Cash-flow management techniques were instituted, and, for the first time, cash flows were projected for two years in advance. Management information systems were also rationalized and instituted throughout the department.

Program development and management activities were organized into a Center for Program Development and Management. In its initial stages, the program development and management concept actually functioned through an ad-hoc task force composed of those bureau- and division-level personnel then responsible for transportation programming.

For the first time, the collective programming capability of the Department of Transportation was pulled together into a single forum. The ad-hoc committee approach was utilized for a period of time while options over organizational concept, structure, and responsibilities were analyzed. Following the appointment of a director for program development and management, the ad-hoc committee dissolved, and the task of establishing a staff capability for the program center moved forward.

The office of press secretary and director of communications was also established to coordinate all liaison with the media as well as with the members of the Pennsylvania General Assembly.

Procedural Framework

The program development process in Pennsylvania now consists of five distinct steps with respect to individual projects: (1) initiate; (2) review and prioritize; (3) select; (4) schedule; and (5) fiscal release. The five steps are assigned in stages and by organizational unit for highway program development. Program development for projects other than highways—public transportation, airport development, and rail—is in various phases of development. The identification of stages and organizational assignments has defined responsibilities and decisionmaking points, and has thus overcome the previous confusion and misunderstanding.

Within the organizational framework, the Fiscal and Systems Management Center prepares multiyear accrual and cash flow projections showing estimated state financial resources available for transportation programs. Estimates, developed around high and low scenarios, are provided to the Program Development and Management Center. The Fiscal and Systems Management Center also reviews and releases projects, phases of projects, or programs prior to formal authorization by the Program Management Committee, and, again, prior to construction letting.

The Program Development and Management Center maintains distinct project assessment, program development, and program management capabilities. For the first time, an assessment of competing requirements and alternatives is taking place in a systematic fashion, providing the foundation on which program options can be developed. More importantly, the information is readily available to top management. The program center prepares and maintains multiyear federal-aid forecasts, within which program development is constrained and within which options for leveraging available state funds are developed. All programs and project authorizations are now released through the program center. By and large, this authorization release is accomplished via a computerized project management system—another innovative step undertaken by the department.

Following certification by the program center, fiscal release by the fiscal center, and action by the department's Program Management Committee, transportation programs, projects, or phases of projects are released to the appropriate operating divisions of the department for implementation. Within these authorizations, any departure from established program schedules is immediately brought to the attention of the program center. Also, any departure from approved scope of work or from approved cost estimates by more than 15 percent or \$500 000, whichever is smaller, must be brought to the attention of the Program Management Committee with written justification.

On a month-to-month basis, appropriately assigned organizational units in the program development process may initiate revisions to the department's adopted transportation programs through submission to the program center. These revisions follow procedures outlined within the appropriate modal priority program (highways, public transportation, and airport development). However, given the dynamics of this effort, week-to-week actions have actually been the case.

Within this framework, the department, through the program center, initiates comprehensive reviews of the

commonwealth's 12-year programs for highways, public transportation and airport development during the even-numbered years (as required by state statute). In turn, the program center reviews progress on a quarterly basis, reporting to the Pennsylvania Transportation Commission.

The department emphasized its intention to cooperate with county and regional planning organizations in its program development process. Given the department's fundamental change in method for transportation programming, planning organizations to some extent felt threatened by the new approach. As the department exhibits its ability to define the highest priority system requirements and to take action to correct these requirements, the change in method is becoming less of a contention between state, county, and regional officials.

Center for Program Development and Management

The program center is the result of significant restructuring efforts within the Department of Transportation. The restructuring has consolidated construction and grant program development throughout the department. The consolidation has been accomplished more by transferring responsibilities previously residing in the operating divisions of the department than by transferring the individuals involved. It was determined that to transfer all individuals involved would be too disruptive.

Restructuring has led to three divisions within the program center: (1) project assessment; (2) program development; and, (3) program management. Figure 3 shows the general organization of the program center.

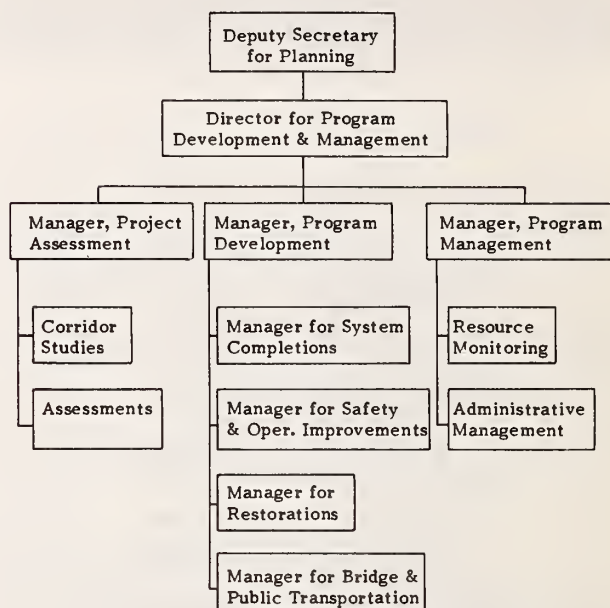
The Project Assessment Division consists of two key organizational functions: assessments and project inventory. While the objectives of these functional activities are many-fold, the overriding objective is to provide the information and data base upon which program development activities can build. In many aspects, the Project Assessments Division reflects of the department's past effort to coordinate its capital improvement program through the single central office unit. Building upon that concept, an evaluation capability has been added, and highway functional classification activities have been assigned.

The Program Development Division does not conform to the traditional organizational staff approach. The division consists of four key program managers with department-wide responsibilities. Each program manager is responsible for one of four key priority program areas. For each program manager there is an assistant manager. Below this level, there is no staff reporting to either the manager or assistant manager. While the manager for the Program Development Division is responsible for the activities to develop, prepare, and maintain the department's overall construction and grants program, the four key program managers are accountable for the variety of individual programs falling within each of the four broad priority groups, as shown in Figure 3.

The program manager's responsibilities cut across the department, including its engineering districts and central office units. In addition to providing guidance and direction to the department's district engineers, bureau directors, and other metropolitan and area planning organizations, the program managers develop and recommend project evaluation criteria, methods of comparison, and priority ranking tailored to the individual program requirements for which they are responsible. The managers also assist in developing procedures and guidelines based on top management objectives and federal and state laws, regulations, and policies.

The Program Management Division consists of two organizational functions: program and resource monitoring and administrative management. The Program Management Division supports and monitors the construction and grants program. Program support revolves around the preparation and coordination of the variety of authorizations and information requirements emanating from the legal, policy, and organizational framework for transportation program-

Figure 3. Center for Program Development and Management—organization.



ming, budgeting, and authorizations. The management function is the interface point within the department for the newly created project management system (PMS).

Products of the Priority Programming Process

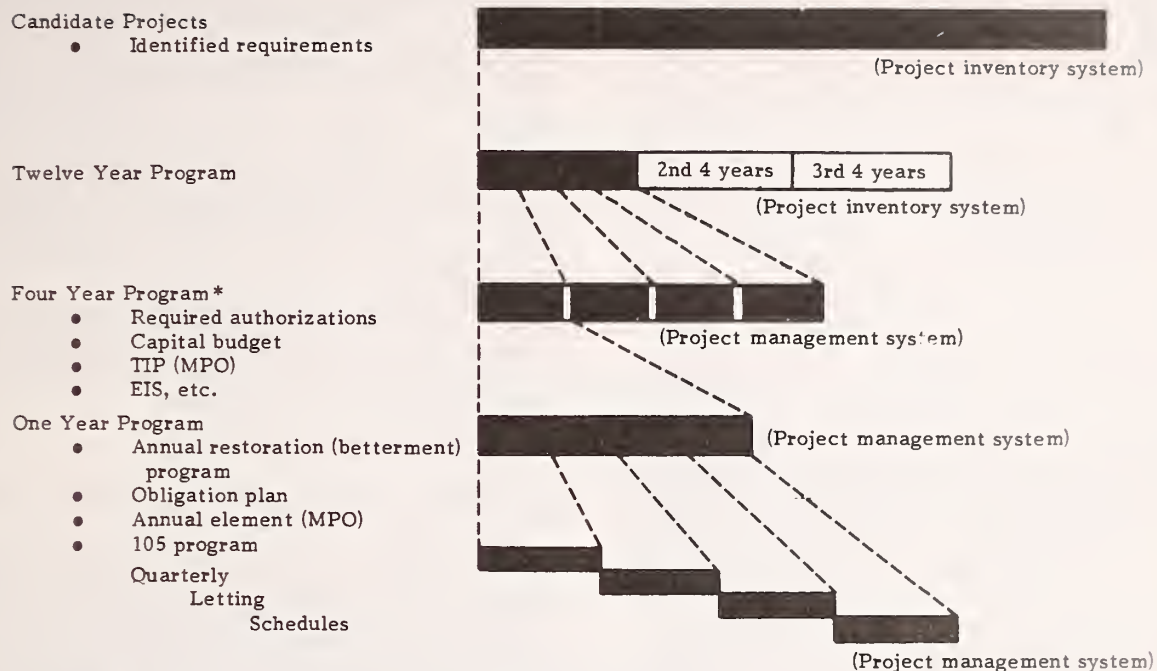
The primary products of the integrated, organizational approach to transportation programming are 1-, 4-, and 12-year programs.

For the 1-year period, there is now a list of project phases by priority grouping that are expected to be active during the year. The list includes the schedule of lettings for specific projects moving to construction during the period. The list is also a reflection of the department's planned federal-aid obligations for the year. Within the year, a detailed reconciliation between project activities and this program occurs. The detailed reconciliation covers cost escalation within estimated cash available and required changes in project scope, costs, or scheduling. These changes may be dictated as a result of project development or as a result of decisions to deliberately downscope improvements to remain within limited financial resources. Detailed reconciliation of this program permits development of a firm letting schedule for public announcement at the beginning of each quarter.

For the 4-year period, there is a list of project phases (by priority grouping) that are expected to be initiated and/or completed within four years. This 4-year priority program enables the department to concentrate its resources—financial, human, and physical—on meeting specific objectives. The program details the list of project phases on which department managers are authorized to work. Compliance with these specific authorizations is ensured through the interfacing of the computerized project management system and the department's computerized accounting system. Both the Fiscal Center and the Program Center monitor authorizations for compliance.

For the 12-year period, there is a 12-year transportation program as required by state law. The 12-year program is reviewed, revised, adjusted, and extended every two years to cover, in general, capital improvement projects. The review and revision effort is undertaken in cooperation with county and regional officials. Recommendations are focused through the Program Development and Management

Figure 4. Program development.



*Includes the Energy Conservation, Congestion Reduction and Safety Program (ECONS)—approximately 2 years of projects identified.

Center, which initiates program development guidelines and criteria. The Program Development and Management Center develops alternative scenarios over the 12-year period based on assumed, alternative levels of federal and state funding. Within these scenarios, options are then developed first for consideration by the Program Management Committee and ultimately by the State Transportation Commission.

Figure 4 shows the relationships between the primary products of the integrated, organizational approach to transportation programming.

SUMMARY AND CONCLUSION

In summary, the key to successful program development in Pennsylvania has been the department's ability to bring together programming and budget functions at the very top level of management. Information and monitoring systems have been instituted that allow top management not only to be involved in decisionmaking, but also to monitor implementation. This is accomplished by active involvement of metropolitan and county planning organizations in the program development process and continuous liaison with the general assembly. Pennsylvania has developed a program that is both sensitive and effective. The department's integrated, organizational approach to programming has enabled Pennsylvania, within 20 months, to nearly double the amount of federal-aid obligated to over \$1 1/2 billion. During this same period, the department focused limited resources on restoration of its extensive existing highway system.

Finally, open, effective programming has been one of the key contributing factors to rebuilding the department's credibility with the general assembly. Two years ago a disenchanted general assembly considered legislation to dissolve the Department of Transportation. In this session, with an overwhelming, bi-partisan vote of confidence, the general assembly enacted a 3.5 percent oil franchise tax to stabilize the department's declining motor fuel tax reve-

nues. For the first time in a decade, the general assembly, as a body, understands and endorses the department's program, believes that it will actually be accomplished, and has provided the revenues to finance it. In a highly partisan state like Pennsylvania, this is indeed a major accomplishment.

HAL KASSOFF

Maryland Department of Transportation

The Maryland Department of Transportation is unique in the country in having seven modal administrations that have both funding and major operating responsibilities. The department is comprised of: the State Highway Administration, which is responsible for 20 percent of the streets and highways in the state; the Mass Transit Administration, which owns and operates the transit system in Baltimore (this responsibility includes construction of a subway system); the Maryland Port Administration, which owns and operates a number of major port facilities in the Port of Baltimore; the Maryland Aviation Administration, which owns and operates the Baltimore-Washington International Airport and Glenn L. Martin Airport; the Maryland Toll Facilities Administration, which operates major toll highways, bridges and tunnels within the state; the Motor Vehicle Administration, which carries out traditional motor vehicle functions, including licensing, registration, and titling; and the State Railroad Administration, which owns and operates certain rail passenger and freight facilities.

Financing of the department's programs is also unique. State funds come from a Consolidated Transportation Trust Fund used to finance six of the seven modal administrations. (The Toll Facilities Administration is funded separately through its toll revenues and the issuance of revenue bonds.) The sources of income to the Consolidated Trust Fund

include fuel tax, titling tax, license and registration fees, and part of the corporate income tax levied in the state. Other income comes from port fees, aviation fees, and transit fares in the Baltimore area. The department also sells bonds that are secured by the trust fund. The trust fund is a true multimodal financing mechanism—flexible yet because of the hard realities of intermodal competition and tradeoffs, difficult to adapt to the philosophy of "balanced" transportation.

The Department's Consolidated Transportation Program includes all modes of transportation. It is a 6-year document and is updated annually. The structure is based on cash flow, with projected annual expenditures for each of the major projects listed in the program shown for each mode. The highway program is developed by the State Highway Administration's Office of Planning and Preliminary Engineering based on fund allocations and a policy framework established by the secretary.

The preparation of a program, if it is to be meaningful both externally as a commitment of the department and internally as a production management tool, has to be a total team effort and supported at the very top. The entire management team at the State Highway Administration is involved in its preparation. The program is submitted by the state highway administrator to the secretary of transportation. The secretary's staff coordinates the modal submissions into a consolidated program. The secretary then approves the total program for submission to the governor and the General Assembly.

The legislature in Maryland receives the program each year as an informational document in support of the budget request. Recent legislation mandates that the program and budget be directly tied to each other to ensure that legislative actions on the budget will have a direct bearing on the approved program.

ANNUAL CYCLE

The annual cycle for updating the program takes 12 months to complete. The starting point for the cycle is in February of each year, when the State Highway Administration initiates its annual cost review for every major project. This ensures that every major project in progress will be subjected to a detailed cost review at least once a year. Most projects are actually reviewed more often.

Project schedules, which are reviewed quarterly by top management, are combined with updated cost information in April. In May, the State Highway Administration develops a preliminary program submission, which is provided to the secretary. Highway maintenance is, of course, the top priority within the operating program. Minor capital improvements involving resurfacing, safety, traffic control, and bridge rehabilitation have the highest priority claim on capital funds. Next in priority is the completion of Maryland's Interstate, followed by major capital projects to improve capacity and safety on the state's primary and secondary system. These program priorities reflect an explicit consensus that has been established between the department and the legislature.

In early summer, the secretary makes one of his most important decisions of the year—the allocation of funds to each of the modal administrations based upon his perception of their needs, the status of their projects, and stated policies, objectives, and priorities.

Based on these allocations, the preparation of the final draft program begins. The principal tie into the budget development process takes place during July and August of each year, when the preliminary work done in budget preparation and the program are linked. The program development process provides updated targets for project costs and schedules. These targets reflect current status, as well as management's decisions to add, defer, accelerate, or eliminate projects.

In September, the final draft program is ready for public distribution. In October and November each year, the

secretary of transportation, the state highway administrator, and key staff visit every one of the 23 counties and the city of Baltimore to discuss the final draft program. The purpose of these meetings is to review all of the projects, major and minor, to discuss whether the department has lived up to its commitments of the past year, to solicit local views and see whether local priorities have changed, and to receive comments or criticisms from local officials. To a great extent, the success of the annual program tour depends on the style and interest of top management participating in the meetings. These meetings can be an important step in ensuring that the department's programs are responsive to policies, plans, and priorities throughout the state and in soliciting support from the elected officials.

In December, the final program, based upon the draft taken on tour and any resulting adjustments, is published. In January, the Consolidated Program is submitted to the legislature along with the budget. In February, the following year's program cycle begins again.

THE HIGHWAY PROGRAM STRUCTURE

The highway program structure is divided into two major areas: major projects and minor projects.

Major projects are primary, secondary, and Interstate projects. Each of these three categories has two parts: construction and development and evaluation. In prior years, when the early development phases of a project were entered into the department's program, inferences were drawn about construction commitments to that project even though there might not have been funding available beyond the planning phase. Now, construction programs represent commitments to specific projects that will be built if revenue estimates and priorities hold firm. If a project is in the construction program, and the revenue projections hold true, then barring changes in priorities or unforeseen production problems, local officials can expect to see construction in the year shown. Projects still in the planning stage, or the earliest stages of design (prior to design approval), are typically not placed in the construction program, but are listed in the development and evaluation section. This reflects an acknowledgement of the importance of the project, its status in the project development phase, and the desire on the part of the department to implement the project sometime in the future. However, inclusion in the development and evaluation section is not a commitment of construction funding.

Priorities for entering projects into the development and evaluation program are developed from a variety of sources: the State Highway Needs Inventory, systems planning processes of the Metropolitan Planning Organizations, and, in some cases, sophisticated local master planning processes. The active involvement of local elected officials is also key to establishing and preserving responsiveness and credibility.

Projects in the secondary highway program must be initiated by the department in each county in the priority order set by the elected officials of that county. This is a formal process established by state law.

For both primary and secondary highway projects, the department prepares systems planning reports, which the elected officials can either approve or disapprove. Disapproved secondary projects can no longer be advanced toward construction. Disapproval of primary projects, however, may be overturned by the General Assembly as a whole. This mechanism was established in recognition of the statewide interest in the primary highway system.

The minor capital improvement program involves "special projects." This category, which is oriented toward system preservation, has the highest priority. Included in special projects are resurfacing, safety, bridge rehabilitation, traffic control, ridesharing, beautification, and emergency. The size of this program is influenced heavily by the need to keep the existing system functioning.

TECHNICAL CRITERIA

The principal technical criteria for identifying and establishing the priority status of all of Maryland's highway projects are (1) safety hazards, (2) structural condition, and (3) service levels (Figure 1).

Figure 1. Definition of principal criteria affecting project priorities.

Safety hazard	Where a clear, identifiable hazard exists posing a danger to people.
Structural condition	Where a physical component of the highway system is deteriorating to the point of no longer functioning adequately.
Service level	Where improvements are identified primarily on the basis of capacity problems involving significant and frequent delays, access requirements, system continuity, and a desire to improve general safety characteristics.

Safety factors apply where there is a clear, identifiable hazard at a particular location that poses a danger to people. Such a hazard may be the unforeseen result of a natural phenomenon (such as the result of storm damage) or may develop over time as a result of changing conditions (such as a hazardous intersection in an area of rapid traffic growth). In many cases, safety hazards can be minimized through adequate highway maintenance. In some cases, the highest level of maintenance may not be sufficient to avoid the need for a capital improvement project. The correction of safety hazards through capital improvements is accomplished through any one of several of Maryland's highway program categories: safety, resurfacing, bridge, and traffic control (Figure 2). While safety features are also included in major projects in the primary and secondary programs, these projects usually involve a general upgrading of highway safety characteristics to reduce the rate and severity of accidents rather than the correction of a hazardous condition at a specific site.

Figure 2. Principal criteria affecting project priorities.

SHA Program Category	Principal Criteria Affecting Project Priorities		
	Safety Hazard	Structural Condition	Service Level
Primary			X
Secondary			X
Interstate	X	X	X
Safety	X	X	
Resurfacing	X	X	
Bridge	X	X	
Traffic control	X		X
Park and ride			X

Note: Some projects which are developed on the basis of structural and/or safety criteria, and which involve unusually high costs, are included in the Primary and Secondary Programs.

Structural factors apply where a physical component of the highway system is deteriorating so that it no longer functions adequately. Structural components include bridges, pavements, retaining walls, drainage structures (gutters, inlets, pipes, culverts), and sidewalks. Here again, it is necessary to devote sufficient resources to maintenance so as to minimize the need for capital improvements involving reconstruction of structures. However, although maintenance can extend the useful life of these structures, it is inevitable that they will require significant rehabilitation, reconstruction, or replacement.

State Highway Administration program categories that are specifically oriented toward improving the structural condition of highways include Interstate, safety, resurfacing, and bridge. While structural improvements may be included in major primary and secondary projects, these projects are not normally based primarily on the need to correct structural problems.

Service factors apply to improvements that are identified primarily on the basis of capacity problems (severe congestion and delays), access requirements, system continuity, or a desire to improve the general safety characteristics of a highway. The major projects identified in the department's primary and secondary highway programs are based primarily upon an identified need to improve the service level of the highway. These include major reconstruction projects, highways on new locations, and the department's ridesharing program.

The role of technical measures in determining priorities is very high for projects that are based upon safety and structural criteria (Figure 3). The State Highway Administration has a variety of quantitative measures, formula, and standards used to determine which safety projects and which structural projects are the most critical and should receive the highest priority.

In comparison, projects based on service levels are affected to a moderate extent by technical measures. Priorities for the secondary program are treated as matters of policy under state law, which stipulates that the department must undertake secondary highway projects in the order established by elected officials. (Of course, the priority determined by the elected officials is influenced by a number of objective, quantifiable criteria derived in local and regional planning and from information provided by the department.) Matters of policy (such as improving highway access to Western Maryland, relieving seasonal bottlenecks on the Eastern Shore, and meeting growth and development objectives) also govern priorities of the primary program to a large extent.

Policies that reflect transportation systems, land use planning, and efforts to establish geographic equity have a major effect on the priority of projects oriented toward improving service levels (such as in the primary and secondary highway programs). These factors have a smaller influence on capital improvements where safety and structural condition are involved. In all cases, the availability of federal aid and the restrictions as to how this federal aid may be used play a major role. (See Figure 3.)

The role of project status (where a project is in the development process) is most significant for major highway projects that involve a lengthy and complex development cycle. It is extremely difficult to fine-tune the production sequence of a large number of major jobs, each of which is unique, and each of which may require 7 to 10 years of planning, engineering, right-of-way acquisition, and construction activities. In fact, it often occurs that the highest priority projects suffer the greatest delays simply because they may be located in more highly developed areas where costs, impacts, and engineering complexity are the greatest. Minor projects based on safety and structural criteria are also influenced by production status. However, where newly identified or unforeseen problems arise, these priorities can be adjusted more readily than the larger, more complicated projects.

Figure 3. Technical measures used to determine priorities.

Principal Criteria Affecting Project Priorities	Typical Types of Improvements	Role of Technical Measures in Determining Priorities	Examples of Technical Measures Used	Role of Transportation System, Land Use, and Geographic Equity Measures	Role of Federal Aid Availability and Restrictions	Relative Weight of Project Status in Determining Priorities
Safety Hazards	<ul style="list-style-type: none"> • Traffic control (signals, signs, and markings) • Guardrail • Median barrier • Control of access • Safety grading • Removal of roadside obstacles • Changes to roadway and intersection geometry • Railroad crossing improvements • Lighting and bridge fencing 	High	<ul style="list-style-type: none"> • Accident rates • High accident locations • Design standards for alignments and cross 	Low	High	Moderate - newly identified safety problems receive high priority
Structural Condition	<ul style="list-style-type: none"> • Bridge rehabilitation • Resurfacing • Drainage improvements • Reconstruction of deteriorated structures (walls, culverts, sidewalks) 	High	<ul style="list-style-type: none"> • Bridge inspection reports • Safety loading limit for bridges • Pavement condition <ul style="list-style-type: none"> - repair records - skid resistance • Capacity of drainage system to handle storm water runoff • Condition of retaining walls 	Low	High	Moderate - unforeseen structural problems can receive high priority
Service Level	<ul style="list-style-type: none"> • Major widening on existing location • Highways on new location • Intersection reconstruction • Park-and-ride lots 	Moderate	<ul style="list-style-type: none"> • Volume/capacity ratios • Overall travel speed • Access to traffic generators • System continuity and convenience 	High	High	High - lengthy and complex project development cycle makes changes in production sequence difficult to accomplish

PITFALLS OF THE PROGRAM DEVELOPMENT PROCESS

A most significant pitfall in highway programming is overcommitment. Not too many years ago, as a result of funding and projection problems, commitments could not be met, and the credibility of the department and the value of the program were very low. Over the past several years, credibility has improved, largely because of the ability to keep on schedule and to control costs.

The program development process should not be allowed to become either overly political or overly technical. A viable capital improvement program is one that is founded on technical criteria, but is responsive to, and in accord with, the predominant views of citizens and their elected representatives.

While the use of rigid geographic distribution formulas can be inappropriate, ignoring geographic distribution and perceptions of equity is also a danger. At the Maryland Department of Transportation, various measures of geographic equity (population, mileage, vehicle miles, registrations, etc.) over a 12-year period spanning both the past and the upcoming six years are used.

Another pitfall is the failure to integrate the published program with internal management actions and production

schedules. It is absolutely essential that a program be a real-time document and integrated with the monitoring and management system.

Among the most serious pitfalls are the failure to detect and respond to changing priorities of decisionmakers; the failure to maintain close and constant contact with elected officials; and the failure to present program and funding options and consequences when faced with a funding crisis.

The basic tool for overcoming these pitfalls is a credible programming process, founded on technical grounds, political awareness, and good common sense.

In sum, the driving force in putting together the highway program in Maryland is an attempt to establish the credibility of the department's priorities, projects, costs, and schedules. The State Highway Administration has been demonstrating its ability to keep projects on schedule and to control costs. Project priorities have generally been reaffirmed. With these basic ingredients, and with support and leadership from the governor, the secretary, and the state highway administrator, the Maryland General Assembly has recently taken action toward providing adequate funding of the state's highway program. The continuing challenge is to deliver this program while constantly striving to improve the highway programming process.

PART 5: WESTERN CONFERENCE

ISSUES ADDRESSED

A. Management Process

1. Organization and Management

- a. How are the several types of programming decisions made in your organization? Is there a formally established listing (in writing) of organizational responsibilities that names the position, unit, or committee responsible for making decisions for the various phases of the management, financial, and programming process?
- b. How do you develop good lines of communication and clear definitions of responsibilities for programming functions?
- c. Some states are setting up formal project review committees to evaluate each proposed project and decide which of the alternative solutions should be selected. How well does this procedure work? Are there formal criteria for making decisions?
- d. How are the data bases for program development, project selection, project award, financial projections, etc., linked together? Is there one official source for mileage, program, or financial information?
- e. How are the construction and operating budgets tied together; i.e., are decisions on manpower planning, maintenance service levels, bridge repair program levels evaluated concurrently at the central office executive level? How are program goals established?

2. Intergovernmental Relations

- a. How are local government programs woven into the state program process? How does the urbanized area TIP process fit into the state process?
- b. What type of state and federal legislative liaison has been established to help further the state program goals?
- c. How are the federal aid requirements and procedures integrated into the state process? How have states obtained administrative flexibility to overcome categorical funding restrictions and obligation ceilings in order to better implement state investment policies?
- d. Legislative and local agencies want to know what may happen under different conditions and levels of transportation funding. How can the programming process be structured to respond to the what-if questions?
- e. What role does the legislature play in project identification and prioritizations?

- f. In most states county and local governments share in highway user tax revenues. What role should local government highway programs play in the state's approach to federal and state legislatures for additional highway resources?
- g. Are state, federal, and local coordination committees a useful mechanism for development of design standards, interagency review and approval methods, development of allocation formulas, and program investment levels?

3. Defining Needs and Alternative Options

- a. What are the long-range planning process inputs that are useful to develop programs?
- b. In seeking legislative appropriations what approach is most effective: identification of total needs or the presentation of a capital program that is constrained by workload schedules and current fiscal resources?
- c. What adjustments have been made to the traditional needs studies to present realistic fiscal requirements to the governor, the legislature, and the public? How can needs studies be used to provide useful input to the programming process?
- d. What mechanisms are used to inform top management of impacts of alternative programs? How are long-range plans used to develop alternative program levels as well as alternative funding levels for various program categories (i.e., resurfacing, safety, signalization, bridge rehabilitation)?

4. Resource Allocation Among Program Options

- a. What criteria are used to allocate resources: geographic, urban and rural, system, program?
- b. What mechanisms are used to convince various constituencies that program funds are allocated equitably?
- c. What management strategies are utilized to develop a flexible program process to accept the changing range of financial resources available?
- d. Has your agency developed any formal procedures for matching resources to various program options?
- e. Once allocation of funds is developed, who takes the lead in program development—local, county, regional, or state government?

5. Marketing (Selling) the Program

- a. Has your state utilized consumer surveys to help understand the expectations of highway users and constituent associations toward your department's current program?
- b. What are your procedures for identifying and contacting the public and constituent groups?

- c. What are your suggestions for improving the information flow process: governor's office, budget office, legislature, local public officials, citizens and public interest groups, user groups, shippers and carriers, and news media?
- d. How has your state established its credibility with the public and other constituencies?
- e. Does your state periodically have accountability sessions with constituencies to indicate program accomplishments as well as problems with program delivery? What are your suggestions for improving accountability?
- f. Has your agency used a public relations program for selling your management efficiency to the voters?

B. Financial Process

1. Establishment of Financial Systems

- a. Some states are on cash disbursement basis, some on an encumbrance system, and others on a modified accrual system for receipts and expenditures. What are the benefits and liabilities of each system? How do they affect the cash flow?
- b. How is your financial system tied to the programming process?
- c. Has your state established any mechanism for finalizing (closing out) federal highway projects in order to speed up final federal reimbursement?

2. Identification of a Flexible/Multiyear State Appropriation/Budget Process

- a. States that have general fund support for their highway programs may have problems with lapsing funds. In such instances how can a stable program and prevention of loss of funding be achieved?

3. Revenue and Cash Flow Forecasting

- a. What methods do you use for forecasting revenues (highway user revenues, general revenue, fund revenues, federal funding, toll funding, severance tax revenues, etc.)?
- b. How do you forecast cash flow requirements? How do you account for cost overruns and projects already awarded?
- c. Discuss assumptions and revenue forecasts (fuel consumption, inflation, rate of growth, curves) for a one-year and five-year program.
- d. What types of models do you use to forecast impacts of inflation on operational costs as well as projects that are in the multiyear program pipeline?

C. Programming Process

1. Establishment of Flexibility Within the Process

- a. Has your state developed any procedures for a quick turnaround in the development and release of a program option?

- b. How do you handle the need to have many projects in the location and design phases of project development because several projects "fall out" of the program prior to letting? In a tight manpower and fiscal situation has this been a problem?

2. Measurement of Current Conditions

- a. What types of condition measurements are useful in the project identification and project prioritization process?
- b. Have you defined minimum standards and adequacy that are acceptable to the public in terms of roadway and bridge physical condition, safety and accident rates, capacity, and congestion?
- c. How do you define the trigger point for the initiation of highway projects?
- d. What cost-effective methods have you utilized to obtain condition ratings? How are your condition files linked to other inventory and programming files? How current should condition rating files be kept?
- e. Are different methods used for urban and rural condition ratings. If so, how do you develop comparability?

3. Prediction of Future Conditions

- a. How do you forecast life expectancy for existing pavements? How do you identify projects and schedule them to enhance life expectancy?
- b. How do you forecast rehabilitation costs of structures?
- c. With the current fluctuations of travel growth, how do you identify future capacity problems?

4. Project Selection

- a. What criteria are used to select projects and how are they weighted? How do they differ for different highway program categories? What criteria are used in weighing one element for one type of project relative to others—for instance, safety relative to surface conditions or bridges to pavement resurfacing?
- b. Projects must now be justified and defended on their own merits as well as links in system development. How has the connectivity of system development affected project selection?
- c. In an era of economic recession, downtown projects associated with job retention and economic development become more important. How do you handle this in your programming process?
- d. Key to pavement life-cycle costs is an evaluation of alternatives that rely heavily on initial high-cost, long-life improvements or on incremental periodic pavement improvements. How do you compare the life-cycle costs of alternatives in the selection of projects?

5. Project Ranking

- a. How do you rate and prioritize roadway, bridge, safety, and other types of projects? How are accident data used in project prioritizing?
- b. To what extent should project prioritization be based on technical and engineering criteria compared with public complaints and political considerations?
- c. Have user surveys been useful in identifying the public's perception of priority ranking criteria?
- d. Do you use cost effectiveness in project ranking? If so, how do you determine cost effectiveness for a project?

6. Scheduling and Control

- a. How is the project priority list updated to take care of slippages and inflated project costs? How are slippages identified?
- b. What types of accountability are established for timely accomplishment of the pre-construction activities and meeting the scheduled letting dates?
- c. What type of public relations programs have been implemented to overcome the criticism of long lead times for construction projects?
- d. What mechanisms such as value engineering, downscoping of projects or design committee reviews have been utilized to maximize cost effectiveness of each project?
- e. What type of monitoring system has been effective to identify project production problems and to correct those problems?

7. Program Evaluation

- a. Do you evaluate your program performance? What procedures do you use to evaluate performance in terms of projects and systems?

D. Programming Model—Attributes and Pitfalls

1. List the attributes that you believe an effective highway programming process should have.
2. List the pitfalls to avoid in a highway programming process.

PAPERS PRESENTED

WILLIAM G. STRINGFELLOW
Colorado Department of Highways

In Colorado there is an interesting relationship between the Highway Commission and the legislature. The Highway Commission is extremely autonomous in Colorado—one of the few states left in that situation, I believe. The Highway Commission has total authority over the funds that go into the highway trust fund. The Highway Commission develops the construction budget, the maintenance budget, the operations budget, and all the manpower staffing levels and FTE levels, and that budget goes to the governor for his signature. He signs it, and the legislature is not involved in any way—at least until this past year. The legislature in the last session passed a law that requires the construction and maintenance and operation budget to go to the House and Senate Transportation Committees for their review and comment before going to the governor. The budget then goes back to the department and the commission; the department and commission are not required to change anything or to take any action on the comments, but they are required to address those comments.

When the budget is forwarded to the governor for his signature, comments must be addressed. The theory seems to be that if the comments are not addressed, then the next year that oversight will be stronger. I think the Highway Commission sees this coming, and I think the Highway Commission from a policy standpoint does not regard that as necessarily bad. The legislators are elected officials, whereas the Highway Commission is appointed by the governor. The Commission understands this relationship, but at the same time there is a sense of apprehension.

As a result partly of this and of other factors, many of the commissioners in commission meetings ask, "How did you select that project?" The Highway Commission is getting very concerned over how and why projects are selected.

About a year ago, CDOH established an internal organizational committee called SOS (Staffing and Organizational Study) to look at some of these types of things. Interestingly, three of the four task forces—engineering, the district office, and maintenance—came out very strongly with the recommendation that CDOH needed a systematic process for deciding how CDOH was spending money, whether it was being spent in a cost-effective way, and what projects were going to be built.

As a result the Project Prioritization Task Force (PPTF) was set up, which I chaired and which had representatives of all major divisions and the district offices. The PPTF looked at whether this was even a feasible approach in Colorado, given certain constraints and conditions. A report was developed as a draft in January 1982 and was revised and published as a final report in March. It was reported that a method was feasible, but it needed a lot of work done, and there were a lot of questions that needed to be answered in order to develop it.

In March the Highway Commission approved this general approach, provided funding to proceed and develop the process in more detail, and directed that this process be used for allocating resources and selecting projects by November or December 1982, prior to the development of the next 5-year construction plan.

The objectives of the PPTF were to develop a decision-making process for prioritizing construction and maintenance projects and types of work, and to refine this process so that it could be used to allocate resources in times of shortages and declining constant dollar resources.

What is the programming process? What Colorado has, and what it will have, at least initially, is not a programming process according to the definition used in this confer-

ence. It does not have a lot of the elements or characteristics of a true programming process. The report noted some of the key characteristics: top management and policy commitment; defined linkages between program development, project management, budgeting, financial planning and management and the decisionmakers; specific authorization mechanisms, specific scheduling procedures, and clearly defined accountable roles and responsibilities; a procedure for monitoring program performance; and the capability of showing options and alternatives, consistency, and visibility. Given where CDOH is today, even if CDOH wants to have a comprehensive and complete programming process, it probably will take a considerable amount of time and probably some organizational changes to do it. Since management does not appear to be ready to do this, the Division of Transportation Planning (DTP), which has been assigned the responsibility of developing the Resource Allocation/Project Prioritization process, has keyed in on what is called a program development process as one element of the whole programming process.

The program development process (1) establishes a procedure to allocate resources among project types and geographic areas on some equitable basis and (2) prioritizes projects within certain key project types to use those resources in what would be the most cost-effective way to achieve the objectives that have been established. The process will answer the question as to how and why the department selects projects. There is no answer to that question right now. The process will not select the projects and will not eliminate the need for county hearings, one source of public input in Colorado, but it will do some other things. It will give some tools for policy leaders to use. It will also allow DTP to project and to show policymakers what the implications of alternative decisions are. They will be able to see, if they allocate more or less money to a certain type of project, over a 5-year period what the condition of the state highway system will be as a result of that decision versus some alternative decision.

Allowing objective and systematic ranking of projects is also important, although that is just one element. This gets back to the commission's questions about why projects are selected. Many times there is not a logical answer or an answer based on any consistent process.

The process is divided into four major flows (Figure 1). The first is policy direction, which is keyed to the Highway Commission. The Commission's direction and guidance drive the process. The objectives that the Commission sets, the acceptable system conditions, the maintenance level necessary to support the objectives, and the definitions of the activities of the Department of Highways are all driven by policy direction from the Commission. Finally, the actual approval of the program and approval of the process is also the Commission's.

All the items in between are tools that can be used to provide the Commission with a logical program and something it can use to make decisions. Staff can allocate resources, staff can do project analysis, and staff can recommend projects based on conditions of roadways, accident rates, or other criteria. Selection is based on many different things—environmental clearances, right-of-way availability, completion of design, and district engineers' and local and citizen input, and other factors. One of the concerns of the Commission from a policy standpoint, I think, is that, once the staff identifies eligible projects based on some logical criteria and then the Commission does not select those projects, or they select different projects (which they have the option to do) it becomes very visible and may put them out on a limb. On the other hand, they are apprehensive about the political implications of continuing to make arbitrary decisions on staff recommendations without soundly based recommendations with background behind them.

Very simplistically, PPTF developed a matrix, which was called a prioritization matrix (Figure 2). Project types were divided into four major categories: existing system preservation, safety and traffic, major construction, and

Figure 1. Major elements of the program development process for construction and maintenance programs, Colorado Department of Highways.

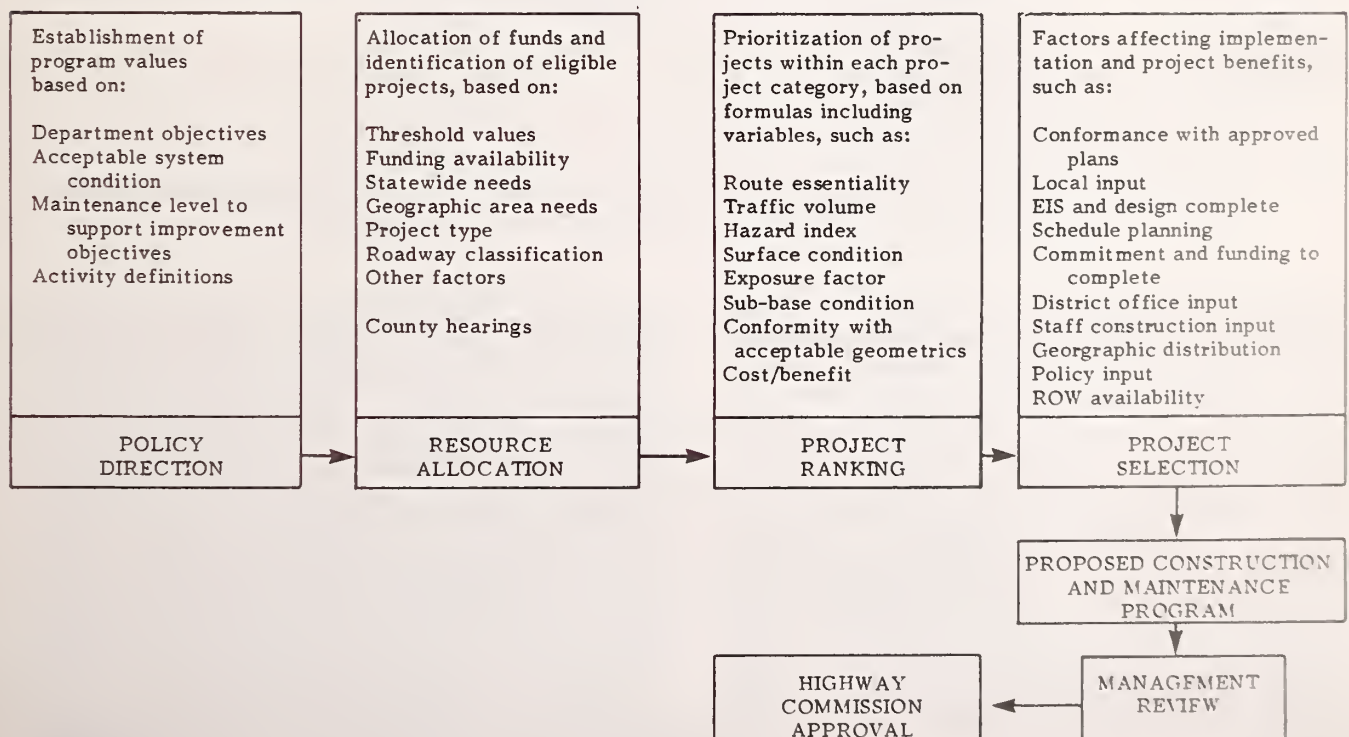


Figure 2. Improvement project categories in priority order by roadway classification.

Interstate	Primary	Secondary	Other SH
Existing Commitments	Existing Commitments	Existing Commitments	Existing Commitments
New Construction: ----- Complete Gaps (if categorical funding is available)			
Existing System Preservation: -----	Existing System Preservation: -----	Existing System Preservation: -----	Existing System Preservation: -----
Resurfacing (essential) Bridge deck replacement Bridge replacement Minor reconstruction Resurfacing (betterment)	Resurfacing (essential) Bridge deck replacement Bridge replacement Minor reconstruction Resurfacing (betterment)	Resurfacing Bridge deck replacement Bridge replacement Minor reconstruction	Resurfacing Bridge deck replacement Bridge replacement Minor reconstruction
Safety/Traffic: -----	Safety/Traffic: -----	Safety/Traffic: -----	Safety/Traffic: -----
Safety - hazardous locations Traffic control Safety - potential hazards	Safety - hazardous locations Traffic control RR separations Safety - potential hazards	Safety - hazardous locations Traffic control RR separations Safety - potential hazards	Safety - hazardous locations Traffic control RR separations Safety - potential hazards
Major Construction: -----	Major Construction: -----	Major Construction: -----	Major Construction: -----
Minor widening	Minor widening Major widening Major reconstruction New construction	Minor widening Major widening Major reconstruction New construction	Minor widening Major widening Major reconstruction New construction
Other Projects: -----	Other Projects: -----	Other Projects: -----	Other Projects: -----
Erosion control Rest areas Park and ride Drainage Bicycle facilities Ridesharing Noise walls Information signs Landscaping	Erosion control Rest areas Park and ride Drainage Bicycle facilities Ridesharing Noise walls Information signs Landscaping	Erosion control Drainage Bicycles Information signs Landscaping	Erosion control Drainage Landscaping

Note: Project types under "Other Projects" are generally shown in priority order, but should be viewed as a group of activities with relatively low priority where individual projects are selected based on overall requirements.

other projects, in that order. That is the order that the engineering committees and the Highway Commission agreed to. First priority is resurfacing, second is bridge deck replacement, third is bridge replacement, fourth is minor reconstruction, fifth is resurfacing (betterment), etc. Those are also stratified by functional category—Interstate, primary, secondary, and other state highways. The essential thrust is that as long as there is categorical funding by Interstate, primary, secondary, etc., priorities go down the list; resurface before bridge deck replacement, and certainly existing preservation before major construction. If changes occur in federal regulations that give, for example, a block grant without categorical funding, the first thing is to resurface primary, secondary, and other, and then do bridge deck replacement, primary, secondary, and other; thus across the matrix. Obviously, there must be some give and take, but essentially, within categorical funding, the intention as far as priorities are concerned is to go down that list. Without categorical funding priorities go across the matrix.

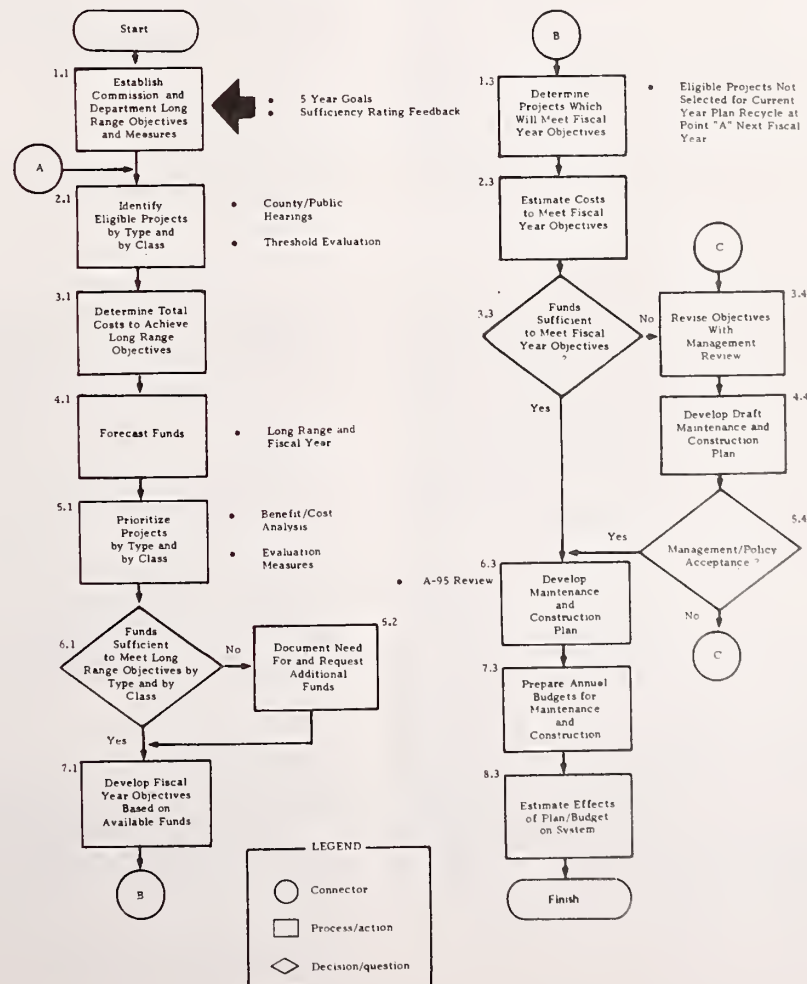
Next, threshold values were identified for various program or project types and roadway classifications to determine eligible projects (Figure 3). Certain criteria were established, based on roadway conditions, safety, and other factors in the sufficiency inventory, and it was determined that once a roadway section reached a certain level of condition as identified by the threshold values, it then becomes eligible (as opposed to selected) for that type of project. Next, those projects within each category are prioritized. If there are 100 sections of roadway in the primary system that need resurfacing—that have a pavement serviceability index (PSI) between 2.5 and 3.0— and only enough money to do 50 of them, which 50 are done? A process is being developed, whereby, once eligible projects are identified, they will then be ranked based on a prioritization process. That will be done for each one of those classifications and for each construction type.

Figure 4 is a schematic of the flow of the process whereby it is determined whether sufficient funds are available to meet the objectives which have been established.

Figure 3. Threshold values for improvement activities

Type of Project	Criteria	Interstate	Primary	Secondary	Other SH
Resurfacing	PSI	2.5-3.1	2.5-3.0	2.5-2.8	2.5-2.8
Bridge deck replacement	Bridge deck rating	4.0	4.0	4.0	4.0
Bridge replacement	Bridge sufficiency rating	50	50	50	50
Minor reconstruction	PSI	2.5	2.5	2.5	2.5
Safety-hazardous locations	HI rating	70	70	70	70
Traffic control	Level of service Traffic delay travel time Average speed public input		UNDETERMINED		
RR Separation	HI rating & exposure factor	---	70 35 000-70 000	70 35 000-75 000	70 35 000-75 000
Safety-potential hazards	PHI rating	---	70	70	70
Minor widening	V/C	---	1.2-1.4	1.2-1.4	1.2-1.4
Major widening	V/C	1.2	1.5	1.5	1.5
Major reconstruction	PSI and HI rating	---	2.5 70	2.5 70	2.5 70
New construction	Estimated cost to build	\$	\$	\$	\$
Other activities			UNDETERMINED		

Figure 4. Program development process.



Staff is in the process of developing some very detailed objectives, which will specify that no roadway will be allowed to drop below a PSI of 2.5 to maintain the average condition of the state highways at a PSI of maybe 3.0. Whatever the specific objectives are, they can be quantified and costs established that are necessary to achieve an objective. Then it can be determined if funds available will allow us to meet those objectives. The process contains a recycling procedure whereby we can repeat the process, and determine what happens if we allocate resources in a different way: What impact does that have on the state highway system? What will the condition of the roadway system be in 3 to 5 years if we do that?

Where are we today? The primary result is that DTP has developed the prioritization matrix and received basic approval of that, which was a major effort in itself. We developed preliminary key indicators and threshold values which are in a constant state of refinement. We have a long-term pavement monitoring program under way to try to determine if the values are appropriate, but we are continuing to refine those. We also are developing project ranking procedures to determine how we are going to rank projects in the resurfacing category, in the safety category, etc.

The secondary results were definitions of maintenance and improvement activities and project types. When we asked twelve different people what maintenance was, and asked twelve different people what resurfacing was, there were twelve different answers. Very specific and clear definitions were developed of what a resurfacing project is—length and depth of overlay, if it is less than 1 inch, it is not an improvement, it is a maintenance activity, etc.—and very clear definitions were made of the difference between maintenance and improvement, and a very clear distinction between project types. They could not be quantified otherwise.

The Division of Transportation Planning is developing our program development process, the Division of Highways is responsible for implementing it, the Office of Management and Budget is responsible for developing revenue forecasts, etc., so it is difficult pulling everything together. That is why at this point it is not really a comprehensive programming process.

Where are we now and what needs to be done next? We have essentially quantified our department objectives. We have developed systems capability, and we are in the process of developing our modeling capability. We must refine the technical data and input. For example, no one in the state has any feel at all for how rapidly or at what rate bridges deteriorate. We have roadway deterioration rates but no bridge deterioration rates, so we are trying to work something out so that at least we can get some idea of how long a certain type of improvement on a bridge will last.

Unit cost estimates need to be refined, and threshold values are in a constant state of revision. We are looking at key indicators: Should we even be using PSI, or is there a better indicator of when a project needs to be done?

Finally, one of the things that really needs to be worked on (it may be a year or two down the road) is the relationship of maintenance needs to projects. We estimate our maintenance budget with no idea or comprehension of how those dollars affect our construction program, or how our construction program affects our maintenance operation. Should less money be allocated to maintenance and more put into overlays in order to get better pavement life-cycle costs? Or can better results be achieved by not doing some of the overlays and some of the other work and by putting more money into maintenance? Will that tend to preserve the roadway and hold it longer? The relationships between those two are unknown, at least in Colorado. What must be done is first determine how much money is needed to maintain our roads, and then allocate the money available to give the most cost-effective use of available funds.

PHILIP W. BLOW Federal Highway Administration

The Idaho state highway system consists of approximately 5,000 miles of paved or oiled highways, including about 612 miles of Interstate highways. The Idaho Transportation Department (ITD) manages the maintenance, rehabilitation, and reconstruction of these highways through six key planning activities: (1) collecting basic information; (2) assessing maintenance, rehabilitation, and reconstruction needs; (3) financial planning; (4) assigning priorities for the identified needs; (5) programming maintenance, rehabilitation, and reconstruction projects to the extent of the available budget; and (6) monitoring and evaluating the effectiveness of the program and the condition of the network.

The ITD is developing a program analysis system for supporting these planning activities and management decisions. At present, the system includes a pavement management system (PMS) for developing 3R improvement proposals, the HWYNEEDS model for developing capital improvement proposals, and the HIAP model for analyzing funding allocations. Funding allocation options are analyzed by types of improvement within both the 3R and capital program improvement categories, federal-aid systems, and state districts. This report describes how ITD uses these three models, how the overall program analysis system is applied, and how ITD plans to integrate them more fully to improve overall analytical capability.

PAVEMENT MANAGEMENT SYSTEM

The present ITD PMS ranks highway sections based on the severity of pavement deflections, roughness, cracking, and friction deficiencies. Also, a composite index of deflection, roughness, and cracking for each highway section is produced as a measure of overall performance.

Data Collection

Because Idaho has a small staff, it is essential that all data be collected and processed as automatically as possible. Consequently, ITD has acquired several automated data collection and processing systems to provide computerized data management capabilities. System data are now collected on magnetic tape and processed directly to the host computer. Through interface programs, the information is merged with other department data files to produce network runs. These files contain traffic volumes and loadings, location, jurisdiction, functional classifications, federal-aid systems, city, county, temperature, and pavement type and thickness.

Pavement condition data are recorded on Hewlett-Packard HP-85 microcomputers. Backup hard copy is also printed on the HP-85. These units incorporate a keyboard, visual screen, printer, and tape drive in one unit. They can be used to check, pre-edit, and reformat needed data. They also drive certain functions of the testing operations in the field and insert location and other data at a specific test site from pre-stored data bases. The keyboard of the HP-85 is used to input supplementary data to the magnetic tape. The tapes are read into the department's IBM 370 through a Datapoint terminal. At present, the department's two Dynaflects, PCA-type (Cox) roadmeter, and MuMeter have been automated in this way. Distress information is coded into the HP-85 during the Dynaflect survey. Work is under way to automate the locked-wheel skid tester.

For collecting vehicle weight data, the department has permanently mounted weigh-in-motion plates and equipment at four ports of entry, two sets of portable weigh-in-motion plates, and a 1½-ton van for housing microcomputers that can be connected to either portable or permanently installed plates. Additional data are being collected on weigh-in-motion plates at ports of entry.

Analysis

Asphalt and concrete pavements are treated separately in the pavement evaluation component of the PMS. For asphalt pavements, remaining structural life is estimated using relationships developed from the AASHO road tests together with Idaho modifications. For concrete pavements, remaining structural life is based on mechanistic considerations, including layer moduli and critical stresses.

The ITD PMS produces separate listings of ranked pavement sections based on indices of deflection (estimated remaining structural life), roughness, cracking, and friction. In addition, the system produces a summary listing, a graphical presentation that shows all four indices for each section, and a weighted average of the indices of deflection, roughness, and cracking for planning information. The system programs will run with one or any combination of indices.

HWYNEEDS MODEL

ITD has implemented the model HWYNEEDS for analyzing capacity and geometric section deficiencies and proposing the improvements appropriate for these deficiencies. The model provides a flexible means for evaluating highway needs based on varying design standards, traffic forecasts, and sufficiency survey data.

Data Collection

Twenty-eight Telac Data Recorders collect traffic volumes and speeds and identify vehicles more than 45 feet in length. The recorders are coupled for Telac communication with the Department's IBM 370 computer. Twenty additional Telac Data Recorders are scheduled for installation in 1982. Data from these portable traffic counters are collected on cassette magnetic tape and processed through a terminal in headquarters.

An instrumented van that can log roadway features at driving speeds obtains cross-slope, grade, horizontal curvature, altitude, bearing, distance, photolog, and other data. Pavement condition information in the form of an index number and foundation rating is obtained from the pavement management system.

Analysis

The HWYNEEDS model (1) determines the deficiencies relative to the input minimum tolerable conditions on individual highway sections, (2) proposes a capital improvement (e.g., reconstruction, isolated reconstruction, major widening, or minor widening) that most effectively corrects the set of deficiencies of each section, (3) estimates capital and annual costs associated with each section, and (4) produces a highway section record with the proposed improvements and costs included and a summary of all section costs as a needs estimate. The model analyzes rural and urban sections separately.

HWYNEEDS also proposes resurfacing or resurfacing with shoulder improvements if only pavement or pavement and shoulder deficiencies exist for a section. However, Idaho relies on its PMS to propose more specific 3R improvement types rather than accepting these proposals from HWYNEEDS.

HIAP

ITD uses HIAP to develop multiperiod investment programs by selecting those improvements that maximize user benefits. The package considers a range of funding options that include minimum allocations for each improvement type, functional classification, and district.

Data Collection

The highway section record built by HWYNEEDS is the input for HIAP, but first this record is reformatted by INTFCE, an interface program that rearranges the record items for direct input to HIAP.

Analysis

The HIAP package evaluates the improvements resulting from the HWYNEEDS analysis in terms of user benefits (savings in vehicle operating, travel time, and accident costs) and agency construction, maintenance, and administration costs. Constrained by the allocation of available funding for a given analysis, HIAP then selects projects, using marginal analysis, that are estimated to yield the most benefit per dollar of costs.

APPLICATION

ITD's program analysis capability has been used to ensure the most efficient use of highway program resources in general; in particular, it has been used to (1) monitor the condition and performance of the state highway system, (2) rank major construction and reconstruction projects of statewide significance, (3) provide resource information to the districts for developing programs, and (4) allocate funds, partially (one-third) based on needs, to the districts. In addition to their use in programming, the analysis results have been used for public information and mileage and statistical reports and for developing criteria for permitting overlength vehicles on certain state highways.

Idaho has improved the output formats of HWYNEEDS and HIAP to facilitate their use by management. At the user's option, needs summaries can be output by HWYNEEDS and project listings can be output by HIAP either unstratified or, consistent with the input allocation of funding, stratified by federal-aid system, functional classification, and type of improvement. The HIAP package has also been used to evaluate major project alternatives in addition to generating optional programs.

ITD has found the PMS, HWYNEEDS, and HIAP models to be flexible, location-specific, well-documented, and based on recognized engineering principles.

PROGRAM ANALYSIS SYSTEM DEVELOPMENT PLANS

ITD has plans to develop further the program analysis system (Figure 1). The system will include an optimization module for the PMS that will interface with HWYNEEDS. At this interface, the system user would generate an optional program by specifying for a highway section which improvement proposal to use—the capital improvement developed by HWYNEEDS or the pavement improvement developed by the PMS. Each program option generated (e.g., full needs, no new locations, widening plus 3R, or 3R only) would result in a new highway section record needed for the evaluation of each option by HIAP. Finally, one option would be selected as a recommendation to the Director and Transportation Board.

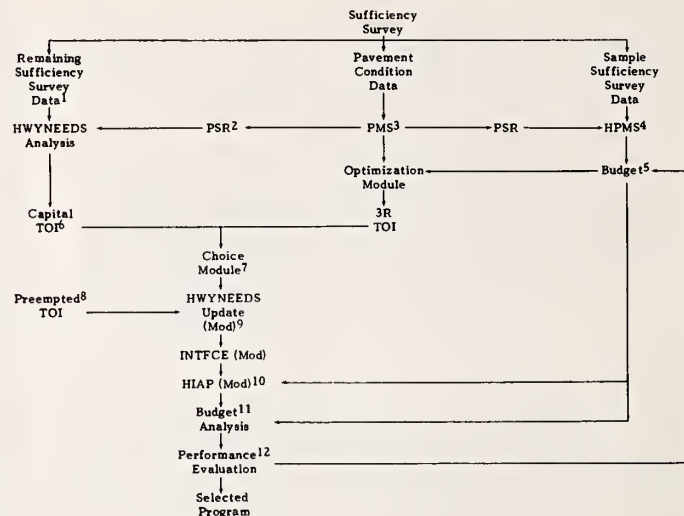
The PMS would use each index of the pavement condition (deflection, roughness, distress, and friction) as estimated by the present system to determine the type of 3R improvement to be proposed to a deficient highway section. The network deflection survey would be used to divide initially those pavements that are predicted to have a structural problem from those that are not predicted to have, within the study period, a serious structural problem due to predicted loadings.

If a deflection problem is predicted for a given section, the other indices are checked to determine the strategy and cost for improvement. These can range from a structural

Figure 1. Proposed program analysis system for Idaho.

NOTES

1. Results of the sufficiency survey less the pavement condition data.
2. Present serviceability rating.
3. Pavement management system (includes the optimization module).
4. Highway performance monitoring system. Either this system or the performance investment analysis process (PIAP) may be used to estimate a preliminary budget.
5. Funding required broken down by program categories and districts.
6. Type (or sequence) of improvement(s).
7. A new module that will, depending on the program option, select either the capital TOI or 3R TOI. Program option examples: full needs, no new locations, widening plus 3R, and 3R only.
8. User can input a TOI where the TOI proposed by HWYNEEDS or the PMS is not found suitable.
9. (Mod) indicates the program or module is modified to take 3R as well as capital TOIs.
10. Highway investment analysis package.
11. For each program option estimates of available resources are allocated on the basis of the constraints unconstrained, TOIs, federal-aid systems, functional classifications and districts.
12. The weighting of each section's performance by its length or VMT to estimate the impact of a program option on system performance.



overlay to reconstruction. If a deflection problem is not predicted within the study period, the other indices are checked to determine whether routine maintenance, recycling, or a pavement overlay is needed. Where friction is a problem, a seal coat will be shown as needed.

More than one 3R strategy for one set of pavement conditions would be considered. For this, the experiences of maintenance and materials engineers on workable 3R strategies for each set of pavement conditions would be compiled into a matrix format that would be accessible by the computer. The various strategies together with associated costs and predicted service lives would be evaluated by the optimization module. The strategy that maximizes user benefits or minimizes life-cycle costs over a predetermined study period would be selected.

Specifically, the optimization module would estimate the remaining service life of new and rehabilitated pavements by type of deficiency as a function of loading (or time, given certain traffic data), consider construction and maintenance costs and user costs associated with various levels of pavement condition, and estimate the budget needed to maintain a given system serviceability level, or, alternately, the serviceability level given a budget constraint. It would also provide an optimum listing of rehabilitation projects for a given budget or serviceability level.

A program option would be generated by the user specifying which improvements developed by the HWYNEEDS analysis are not to be included in the option. For example, for the "widening plus 3R" option, new location, reconstruction, and isolated reconstruction proposals developed by HWYNEEDS would be rejected. In lieu of the HWYNEEDS proposals for these sections, one of the improvements developed by the PMS would be inserted in the appropriate section record through the cost update module. For those highway sections for which HWYNEEDS developed a resurfacing or resurfacing with shoulder improvement, the record would be updated with a more specific pavement improvement type developed by the PMS (rather than having the more general improvement type continue through the analysis). Similarly, for the "full needs" program option, only the section records for which HWYNEEDS developed resurfacing improvement types would be updated with the PMS-developed improvements. For the "3R only" program

option, all section records having an improvement proposed by HWYNEEDS would be updated with the improvement proposed by the PMS.

Further, the HWYNEEDS, INTFCE, and HIAP programs would be modified to take the additional improvement types developed by the PMS. This would permit the needs estimates and priorities for PMS improvements to be output the same as HWYNEEDS improvements are now.

ITD also plans to develop a system performance evaluation module similar to that in the Highway Performance Monitoring System (HPMS). All of this analytical capability will enable ITD to evaluate alternative performance and design standards, other policies, budget levels, funding allocations, and trade-offs among program and project options.

SUMMARY

The Idaho Transportation Department is using a series of available computer programs and other technology to coordinate the inventory, analysis, programming, and budgeting activities of highway planning, construction, and maintenance. The systems are mostly operational, and refinements and updates are under way. In addition to programming and budgeting, products from this system are being used in many other areas throughout the department.

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New Mexico State Highway Department

New Mexico's experience has been much the same as that of other states. The State Highway Commission decided that we needed a new process, and we had to develop something in less than 3 months and have a 5-year program the following month. It turned out to be 6 months, because the commission could not agree on all the elements that we were giving consideration to.

In the course of developing the process it has become acceptable in New Mexico, and that is what is important—something that is acceptable to the legislature, to the staff, and to the citizens of the state. That is what we were aiming for when we started and what we ended up with.

The result is that at the last two sessions of the legislature there was not a single pet project or pet program initiated that was not developed by the department. Any project introduced during the session of the legislature was generally sent to the department and we were asked if it is in our 5-year program. If it is not, it does not even get beyond committee. I think that is a measure of the success of a program. It may not be the main reason you develop a program, but it is one you need if you are to have any credibility in your program. You can work within the program and at the end of the year your lettings match your programs. The department is thus able to plan its program from year to year. We believe that our annual program is credible; the legislature has not changed our program, and I think that is an indication that our process is acceptable. We have initiated hearings in every county of the state to explain the program and the processes of selecting projects. I think those at the hearings felt that we do have a process and that we have selected the projects that are most critical in each of the counties and each of the districts.

The first inventories of the use and condition of New Mexico's roads began in the early 1930s. Today's condition rating procedure grew out of this first inventory. We use only one rater, following specific guidelines to maintain rating consistency. Each indicator is valued as a par value, and the total is 100. A road rated 100 must be thoroughly sound, free of design hazard, and capable of handling present traffic demand.

New Mexico does not have a cut-off point to identify the sections that need improvement first. Instead we look at the foundation, safety, surface, and capacity separately. Extensive foundation failure throughout a road section will rate a zero, and the section is deficient.

The number of times certain conditions appear in the rated section, such as inadequate stopping sight distance, horizontal curves sharper than permitted by the design speed for the road section, and bridges narrower than the traveled way, determines the safety rating. A section is considered safety-deficient when such conditions average two or more in each mile.

The 30-point range for the surface rating is subdivided. The first signs of failure rate a 15: progressive failure although the road is still in usable condition is rated between 15 and 10. A rating of 10 or less justifies improvement and indicates deficiency.

The capacity rating shows the relationship between the volume of traffic currently using the section and the ability of the section to accommodate such traffic. A rating of 10 or less indicates that present traffic is higher than desirable for adequate service, and the section is deficient.

The total rating is adjusted up or down depending on the relationship between the traffic volume of the rated section and the traffic volume of the system of which it is a part. The traffic prioritization scheme gives weighted condition ratings, weighted average daily traffic, weighted accident rates, and weighted socioeconomic factors.

The formula produces priority ranking numbers between 0 and 100; the lower the number, the higher the priority. All rural sections of roads that are rated as to condition, and bridges eligible for either replacement or rehabilitation,

are prioritized. Funding categories are selected. Then improvement projects on deficient sections of the roads, and deficient bridges are assembled under appropriate funding categories in priority order by district. Construction money is divided among the highway districts based on their needs. Annual elements of the construction program match district funds with district priorities. District meetings are held to present the program and receive comments from the district staffs. Public meetings are organized to discuss the program and its effect on the community and to promote public participation. The program becomes official when it is reviewed and approved by the Chief Highway Administrator and the State Highway Commission.

A recently implemented highway needs program is expected to provide some measure of the success of the construction program and should demonstrate to the legislature and to the public what increased levels of highway funding will buy. When highway needs are combined with the Federal Highway Administration's highway investment package, the results are expected to help state, regional, and local organizations make the best use of limited funds.

The purchase of a second-generation photolog system in 1979 provided a response-type roughness-measuring device and paved the way for using objective roughness measurements in rating surface conditions. Roughness is measured in inches per mile. Subjective distress evaluations become more objective when rating forms are used that assign values and weights to the severity and extent of various types of distress.

The pavement management system now being developed assigns different values to the condition indicated. The surface ratings are based on rideability, or roughness, and on distress. The pavement management system will no doubt undergo subsequent improvements. A long-term pavement monitoring program has been initiated that will likely prove to be the major data source for system improvements.

New Mexico has implemented a computerized project scheduling and monitoring process to assure that the 5-year construction program moves toward completion, and not in all directions at once. Based on project data fed into the department's computer, the process schedules activities, such as environmental impact studies, geological surveys, bridge design, traffic design, road design, right-of-way acquisition, and all other project-related activities. The scheduling program produces management-unit activity schedules, 12-month project-letting schedules, long-range project-letting schedules, inactive project lists, and much more manpower, project, and funding information. Continuous updates of the activities of each unit keep the program on schedule.

The process takes stumbling blocks in stride. A unit copes with projects that for some unforeseen reason suddenly go down the drain. The program management capability can quickly assess the impact of funding changes and provide program alternatives. This approach has been used successfully to secure additional funding from the legislature.

It takes a team effort to implement the department's construction program, and the scheduling and monitoring process helps keep the team in step. The projects reach bid-letting as scheduled. The legislature and the public are better informed about the construction program, and the department has a management process that will program the orderly, efficient, and economical improvement of New Mexico's highways.

IAN MACGILLIVRAY
Iowa Department of Transportation

To understand the Iowa programming process, it is necessary to know a little background. Iowa's institutional structure is such that the State Department of Transportation is responsible for only about 10 000 miles of highway out of over 112 000 miles of road in the state. We share that responsibility with city, county, and state governments. In fact, we share funds that are collected into a state road use tax fund with those three levels of government. We get less than half the total pie. That tells something of the scale of our responsibilities.

Our budgeting process is another aspect that relates to the program and management. We have a unique process in that we submit to our legislature an operations budget for our department, although it is, in effect, a lump-sum budget for operations. The remaining part of all road funds that are available to the department come on a cash-flow basis and are managed by the State Transportation Commission without recourse back to a legislative review and approval process. The State Transportation Commission, under whose jurisdiction we operate, has the sole authority and responsibility for the expenditure of all funds other than the legislatively approved budget, which is just for our staff operations and our routine maintenance, and even that comes to us in one lump sum, so we have the ability to switch things back and forth a little. We are managed by a State Transportation Commission that is fully independent. It is appointed for a 4-year term on a statewide basis (the members do not represent wards or districts). They hire and appoint the staff. The governor does not appoint the director. This has led to fair stability in the program development process.

Iowa's Department of Transportation was created in 1975, and at that time an effort was made to respond to the issues discussed here— integration of planning, policy, program, and commitments. Thus we have in the department a centralized planning and programming process; all program-related activities are in one division. In fact, the programming for all of the modal programs is in one office; the same office that is involved in highway programming is involved in airport and railroad and public transit programming. We think we have become fairly successful in the last few years in integrating public policy, fiscal management, the management of the physical systems, and the best use of the capabilities we have with limited manpower; that is all a part of the programming process. It is a management process rather than technical support for management, and programming is really a part of policy management in the department. It is involved in everything from crystal-ball forecasting and linkages all the way through to project management—that is, the individual assignment of work activities in project development, ranging from soil surveys and land surveys to engineering development for project plans themselves. We have a very strong linkage from cash flow management all the way through to construction management.

The programming thus involves the assignment of all our resources to meet all our problems, and it does involve coordination with the staff of the other divisions. The rest of the department is organized on a modal basis, so the highway program area is involved with people responsible for the construction and maintenance and operation of the highway program. We develop both a 1-year current highway program and a 5-year program (that is, the following 5 years), so we are looking at a 6-year program development project.

To understand our process today, it is necessary to look at a couple of other things. Our fiscal perspectives today are different from what they were only a few years ago. Initially, program management was primarily the process of deciding what came next in the process of developing a public road system. Today it is different; it is management and conservation of what we have already invested in.

Financial resources are a serious constraint, and they have led to changes in the whole program process.

We also have some statutory matters that are perhaps different from most. We have two very explicit guidelines for this management process from the state legislature. The first is that we are under a mandate to equalize highway service around the state, and today that can be characterized as share the grief. Perhaps our best management philosophy now is that we would like to see everybody leave with a frown. We get a little nervous when somebody leaves with a grin after having dealt with us.

The other mandate we are under is to publish the program and to abide by it. We must publish annually what our program is, and as a result the issue of public credibility becomes an important question for us with that type of exposure on the entire process. It is laid out publicly on the table in front of everybody in the state.

The process, though, is done with our Transportation Commission, rather than for it. This is not a backroom boilerplate process of developing something that, if the Transportation Commission decides for whatever reason they want something different, they are in the position of having to disagree with a technical exercise that perhaps came out of number generation in the back room that decided a certain project is number one. Instead, the process is done in intensive public workshops with the Transportation Commission, right down to the level of dragging through the numbers, through the minutiae, through the methodology. Then they also bear some accountability along with us.

The process itself in the last few years has had to respond to new directions. For instance, for years we have been involved in functional classification studies. We have tried to prioritize our use of resources on the basis of functional classification, but functional classification does not really cut it. There is not enough money to deal with even our higher level systems and their problems, so we have gone a little further and classified our road system into four levels of service, not in the context of traffic service on the roadway but rather transportation service to the state. We have then allocated and prioritized our resources to meet those service requirements. We identify them as an A, B, C, and D system; although they translate back to a network, they translate back into a lot of other policy decisions, too. What started out as almost an academic planning exercise today has been translated back into maintenance operations as well as program management.

One of the first steps in our methodology is to identify what our needs are, or backlog of needs, not in the classic needs study approach, but rather from our systems planning, from our condition needs surveys, corridor studies, and a number of other things, then to relate those to our funding, and to identify those needs in the context of managing a mature system rather than a developing system. We translate that into an allocation of funds.

What we have done with policy direction from our commission is to identify three types of activities—maintenance, preservation, and improvement, in that rank order. Our budget commitments today are 100 percent commitment to what is necessary for maintenance first; what is left is used for the rest of the program. Then for preservation it is essentially a commitment to 100 percent effort for preservation of the system. What is left is used for service improvement; that might mean meeting capacity or construction requirements, or improving safety of facilities. So we are driving our allocation process on a top down basis—maintenance first, preservation second, and whatever is left, which is not very much, third.

This certainly answers the questions, and it also avoids some difficult issues for us on what is more important, the maintenance of a particular piece of pavement on a high-volume road, or the replacement of an embargoed bridge on a low-volume road, or the four-lane widening of an urban commuting road.

In the process we have also allocated funds among the four classifications of highways, A, B, C, and D. Basically we are going to meet the service, preservation, and maintenance needs to the fullest we can on our highest level system, and what is left shakes out from the bottom. If there is anything left for those low-priority roads for things like service improvement, fine, but if there is not, we are going to live with one-lane bridges, with pavements that will only get potholes patched, with embargoed weight limits on bridges down to 5 and 6 tons, and if necessary, even with closing a few bridges. We have not quite gotten to that stage yet, but we may well have to. Again that avoids facing some of the issues, of course, but it does lead to a fairly straightforward process for deciding where within those allocated areas we will put our funds.

First of all, in allocating funds we look at what our total needs are for preservation of the system. For instance, how many miles of pavement will have to be repaired and replaced in the next year, the next 5 years, the next 10 years? That brought us to an analysis of life-cycle expectancies for pavements and then earmarking enough money to manage that part of the system.

Maintenance was the first area prioritized. Today this same programming process is translated back into maintenance policies that prioritize even where hauling and snowplowing will be done and in what degree that level of service will be provided. For many years we functioned with a traditional sufficiency rating process that was oriented toward how good a job the road was doing in meeting the transportation service requirements imposed on it. We found in the last few years as we switched from the developing mode to a maintaining and preserving mode that this is not an adequate process anymore, and we are developing and maturing a pavement management system. It is not fully in place yet, but we are working with indicators such as PSI, traffic and load history as a part of forecasting, life expectancy, skid resistance, deflection, dynamometer testing, visual inspections, and crack and patch surveys. We are purchasing a cross-section measuring device for automating the collection of rutting information, particularly on flexible pavements.

We have taken a look at the lessons learned in maintenance over the years and compared them with the actual road tests, and we concluded that our management process is not as applicable any more. As a result, old ideas like a design life being 20 years are not a major consideration, and in programming we look at a life-cycle analysis and expect that our pavements with proper management are going to last about 60 years and our bridges about 60 years, and that timing our investment is very critical in achieving that maximum life expectancy.

This has brought a close tie between physical engineering and program management for the first time since some of the departures in the early 1960s, when program management started out as an engineering effort.

One of the principal things we have attempted to do in the past few years has been to maintain the credibility of our program. This has been a difficult process of living within greatly constrained financial resources, but we have in effect identified a program of only what can be achieved. Different states vary as to what they identify in their programming process—from an initiative to identify what projects might be developed down to, in our case, the identification of what projects we can develop. Not what we would like to, but can.

The stability of our program perhaps reached, after a few dislocations with inflation and income reduction, a little plateau again this year in that our 1-year program was very successfully advanced from the next year of our 5-year program with very little change. This was a measure of what kind of job is being done on that 5-year programming process.

R. S. WILLIAMSON, JR.
Texas State Department of Highways
and Public Transportation

In the early 1970s the Texas Highway Department faced a financial crisis characterized by increasing costs, decreasing revenues, and increasing demands for improvements to the highway system. In 1975 the department hired McKinsey and Company to study the crisis and recommend an approach to resolving it.

Historically, construction and maintenance projects were developed initially at the district level, where departmental representatives were in close contact with citizens regarding their area highways. These projects were evaluated by the districts and the headquarters office, and at the time of the McKinsey study there was a backlog of over \$11 billion authorized, with a shortfall in funds for these projects. The McKinsey report recommended a system approach to planning projects, and the legislature passed what we called House Bill 3. On the recommendation of McKinsey and the legislature, the department developed a 20-Year Project Development and Control Plan. Each district submitted its recommended projects and priorities, and the final evaluation and selection process was accomplished by a special full-time task force. These recommendations were reviewed with the administration and the Highway Commission, and a comparative analysis was made to establish priorities and to optimize a statewide system development.

In this system approach to planning there are three factors that must be given consideration: (1) unprecedented population and economic growth patterns in certain areas that have overtaxed transportation systems; (2) the emergence of the principal arterial system, in which the basic system of highways has taken form and the transportation corridors most essential to the movement of people and goods have been identified; and (3) limited funding in an environment of spiraling inflation and shortage of resources.

House Bill 3, passed by the 65th Legislature, assured the long-range funding required for long-range planning. House Bill 3 also established funding limits that will require comparison between the availability of funds and commitments to needed improvements over future time periods. These comparisons between needed improvements and available revenues have revealed that many viable improvements to the state highway system cannot be provided in the next 20 years. Prior to House Bill 3, the department's income was from dedicated funds, gasoline tax, and vehicle registration. House Bill 3 provides for the use of state general revenue funds to supplement the present funds. Only those priority projects considered to contribute the most to the overall transportation system can be included in the 20-year construction plan, while many other worthwhile projects must be deferred or dropped entirely if additional funds are not available.

House Bill 3 set a statutory base of dedicated state revenues for the State Department of Highways and Public Transportation. As directed by House Bill 3, the department developed a highway cost index (HCI) based on the weighted annual cost of highway operations, maintenance, and construction. The statutory base amount is adjusted annually by the HCI and approved by the Highway Cost Index Board. In addition, this index and its component indices have been integrated into the department's automated Highway Fund Forecasting Model (HIFUND). This permits long-range planning of the department's operations, maintenance, and construction activity by protecting the statutory base amount against rising levels of inflation.

The HIFUND projects department revenues from all sources over a 20-year period. The model then uses a fund projection in combination with state and federal funding priorities, state and federal transportation legislation, and other policies and procedures pertinent to the highway program to project the expenditures for all department

programs and activities over the same period of time. The expenditure projections are used as funding constraints, on a year-by-year basis, for all operation, maintenance, and construction programs in the department's adopted 20-year Plan. Revenue and expenditure projections are treated as constant sums.

The Finance Division is responsible for the HIFUND projection and for the estimated funds available for the One-Year Letting Schedule. The Highway Design Division develops the One-Year Letting Schedule to meet the projected funds for each category and each federal program.

Realistic funding forecasts are the cornerstone of the department's program controls. Establishing realistic funding constraints at the beginning of the plan development is not sufficient, since funding forecasts are likely to change as time passes. Changes in federal funds, as an example, will directly affect the 20-Year Plan. If funds increase, the time for completion of the original 20-Year Plan will decrease. If funds decrease, the required time period will increase.

A principal arterial system of a little over 10 000 miles was developed that includes all presently designated Interstate highways plus all major highways having the following characteristics: routes serving corridor movements whose trip lengths and travel density characteristics are substantially statewide or interstate travel; routes serving urban areas of 50 000 population and over as well as the majority of those urban areas with a population of 25 000 to 50 000; and routes providing an integrated network without stub connection. This system generally was the same as that developed from the functional classification system and had local governments' approval.

The 20-Year Project Development and Control Plan (Figure 1) is divided into four time periods; these are all focused on the development of a monthly letting schedule to

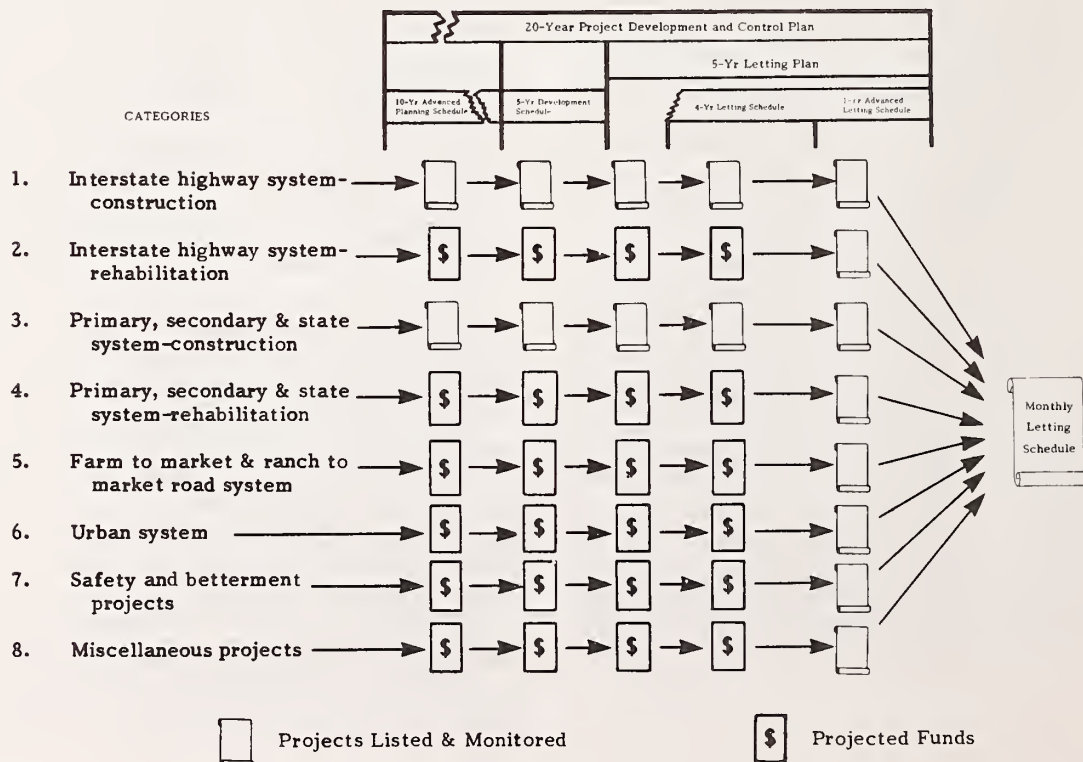
put projects under contract. The four schedules are as follows:

- **One-Year Advance Letting Schedule**—This schedule includes authorized projects in each of the eight categories of construction projects anticipated to be let in the fiscal year. From this schedule, the monthly lettings are developed.
- **Four-Year Letting Schedule**—Projects listed for Interstate, primary, and secondary state funds are for construction and the purchase of right-of-way. This schedule and the One-Year Advance Letting Schedule comprise the Five-Year Letting Plan.
- **Five-Year Development Schedule**—Projects are authorized for the preparation of route studies, environmental reports, public meetings, hearings, schematics, and determination of right-of-way requirements. Some right-of-way may be acquired where agreements for acquisition have been previously approved.
- **Ten-Year Advanced Letting Schedule**—Projects listed in this schedule are authorized for advanced planning and feasibility studies only.

The development of the 20-Year Project Development and Control Plan for construction projects consists of eight categories, as follows:

- **Category 1, Interstate Highway System Construction**—These projects are, of course, controlled by the necessary completion of the system as defined by the 1981 Highway Act, and this is a matter of prioritizing them on a statewide basis.
- **Category 2, Interstate System Rehabilitation**—This is now the 4R system. Priorities at this time are

Figure 1. Twenty-year project development and control plan for construction projects.



on pavement rehabilitation. Each district submitted suggested projects, which were reviewed in the field by the Pavement Design Section, a report was made on each project, and priorities were selected. A program was prepared for a 2-year period and approved by the Highway Commission.

- Category 3, Primary, Secondary, and State System Construction—These projects include all types of construction improvements to roadway and structures on the Federal-Aid Primary, Federal-Aid Secondary, and State Systems that generally add capacity. Category 3 covers approximately half of the funds available, and these were the major projects in the 20-Year Project Development and Control Plan.
- Category 4, Primary, Secondary, and State System Rehabilitation—This category is 100 percent state-funded and includes projects generally greater in scope than the major maintenance and safety and betterment programs.
- Category 5, Farm-to-Market and Ranch-to-Market Systems—District Engineers meet with the County Commissioner Courts and receive their recommendations for new construction projects. This category is very limited, as the legislature provides only \$15 million per year out of general revenue funds.
- Category 6, Urban System—This includes the projects eligible for federal funds on the designated Federal-Aid Urban System. These projects are selected by local officials, and concurred in by the department and the Federal Highway Administration.
- Category 7, Safety and Betterment Projects—These are 100 percent state-funded projects to protect the highway investment and enhance the level of service on existing highway systems. They are generally seal-coat projects or very thin overlays.
- Category 8, Miscellaneous Projects—These include specially funded and federal-aid projects such as bridge replacement, railroad crossings, safety improvement, and similar tasks. Projects in this category are generally developed to qualify for special federal-aid funds and are planned to improve and correct specific deficiencies.

It is important to recognize that all districts and/or geographic areas of the state do not have the same requirements for highway construction relative to the eight categories of work. Several districts have little or no Interstate highway routes, whereas other districts have large Interstate highway construction mileage. All areas of the state have well-defined systems of primary, secondary, and state highways with basic design features usually meeting current standards; however, large segments are in great need of repair and rehabilitation. Where gaps exist in the principal arterial system and in high-growth areas, projects are usually related to the completion of a designated system or a complete reconstruction of highway facilities to increase capacity and improve mobility. Most of the projects in Categories 1, 3, 5, and 6 are proposed to address system completion and capacity needs. Categories 2, 4, 7, and 8 primarily contain projects to upgrade, rehabilitate, or improve existing facilities. The criteria used in selecting and scheduling projects are described more specifically in the following paragraphs.

As previously stated, approximately 50 percent of the work in the 20-Year Project Development and Control Plan is in Category 3, Primary, Secondary, and State System Construction. Projects for Category 3 were recommended by the district and selected by the Austin headquarters for development and construction. The criteria for the selection of these projects depended on whether the project satisfied a system need or a local service need. Projects satisfying system needs are generally on the principal ar-

terial system or contribute to or support that system. Projects satisfying local service needs in high-growth areas are generally off the principal arterial system and provide improvements to satisfy local-service traffic demands. Projects that are deemed necessary to satisfy a system need are evaluated and selected according to the following criteria: route capacity, route continuity, route geometrics, route service ability, and route mobility.

A computerized design-construction information system has been developed for managing the 20-Year Plan. This system monitors the advancement of projects from the issuing of preliminary engineering authority through the various schedules of planning and construction. Each project is assigned a control-section-job number, which is the controlling feature in tracking the project. One of the inputs by the district is the recommended letting date, and from these are taken the projects the districts recommend for the One-Year Letting Schedule and monthly letting schedule. In June, the One-Year Letting Schedule for fiscal year 1983 (September 1, 1982, through August 31, 1983) was completed and approved. These projects then are scheduled for monthly lettings.

The One-Year Advanced Letting Schedule is over-programmed by 20 percent to add flexibility to the fixed categories of federal funds and to allow project slippage due to unclear right-of-way or utility adjustments. This also provides plans that are ready should additional obligation control become available. The Federal 105 Program is also developed from this printout.

As projects are let for construction, the actual letting cost is monitored against the authorized funds, and the districts are credited with the pluses or minuses. These programs are managed by the Highway Design Division and the Program Engineer. The Highway Design Division is responsible for monitoring the projects in Categories 1 and 3 and the Program Engineer keeps up with the other projects. The Bridge Division is responsible for development of projects for bridges and for rehabilitation that is developed from the bridge inventory. Funds are allocated to the districts on construction projects on a statewide basis in Category 3; 4R funds are allocated statewide based on actual inspection of pavement conditions. Urban system funds are allocated on the basis of population. Texas has seven urbanized areas over 200 000 population, where more than 50 percent of the allocated federal funds are spent; other projects in urban areas are discretionary funds and are allocated to the districts based on population. Safety and betterment programs and state rehabilitation programs are distributed on a formula based on the number of lane miles, vehicle miles traveled, and cost index in each highway district. These projects are, of course, selected by the District Engineers.

Each of our districts has a planning engineer who coordinates the 3C planning and development of the annual element in the TIP, in cooperation with local governments, counties, and MPOs. The TIP shows the local projects in addition to proposed federal- and state-funded projects.

The state legislature meets every 2 years, and the department prepares a budget for these 2 years in which we include the total operation of the department, broken down by operation, maintenance, and construction. At present, sufficient funds are not available to construct the projects in the 20-Year Plan, and the plan did not account for the growth that is occurring in Texas. The department is in the process of developing an operational planning document study in which all the districts, in cooperation with local authorities, prepare a list of all projects that will be needed by the year 2000. This includes new projects and the upgrading of present facilities to meet traffic demands. Also, delegations from the large cities are appearing before the Highway Commission with their recommended year 2000 plans. The data have been computerized, and a priority index is being developed on all of these projects. The Commission is studying this plan and has prepared a recommendation to the legislature, which convenes in January 1983, for additional funding.

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HARANO, Tetsuo, Highways Division, Hawaii Department of Transportation, Honolulu

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HICKMAN, Bob, Federal Highway Administration, Denver

HUMPHREY, Thomas F., Massachusetts Institute of Technology Center for Transportation Studies, Cambridge

JUHASZ, Barna, Office of Transportation Planning, Federal Highway Administration, Denver

KIETZMANN, Glenn E., Transportation Systems and Programs, South Dakota Department of Transportation, Pierre

KLAMM, Carl E., Missouri Highway and Transportation Department, Jefferson City

LAIRD, Ivan L., Nevada Department of Transportation, Carson City

LINZIE, Merritt H., Office of Highway Programs, Minnesota Department of Transportation, St. Paul

MACGILLIVRAY, C. Ian, Planning and Research Division, Iowa Department of Transportation, Ames

MCCORMICK, Eugene R., Statewide Program Planning, Office of Planning and Programming, Illinois Department of Transportation, Springfield

MCLAIN, Tom L., Washington State Department of Transportation, Olympia

MICKELSON, Robert P., Planning and Programming Support Group, Arizona Department of Transportation, Phoenix

MOEHRING, D.H., Project Management Branch, Oregon Department of Transportation, Salem

MURPHY, Monty C., Planning and Research, Oklahoma Department of Transportation, Oklahoma City

NEUMANN, Lance A., Cambridge Systematics, Inc., Cambridge, Massachusetts

REED, Marshall F., Highway Users Federation for Safety and Mobility, Washington, D.C.

RINGER, Robert G., New Mexico State Highway Department, Santa Fe

ROBERTS, Richard B., Utah Department of Transportation, Salt Lake City

SAKAGUCHI, Robert K., Colorado Department of Highways, Broomfield

SAUNDERS, Michael, Region 8, Federal Highway Administration, Denver

SINHA, Kumares C., Department of Civil Engineering, Purdue University, Lafayette, Indiana

STRINGFELLOW, William, Colorado Department of Highways, Denver

TEAGUE, Steve, Arkansas State Highway and Transportation Department, Little Rock

UMLAUF, John, Statewide Transportation Planning, Alaska Department of Transportation, Juneau

WILLIAMSON, R.S., Design Operations Highway Design Division, Texas State Department of Highways and Public Transportation, Austin

APPENDIX B

BIOGRAPHICAL DATA ON MEMBERS OF THE PLANNING COMMITTEE FOR HIGHWAY PROGRAMMING WORKSHOPS

DEES, Dan C., (chairman), born December 1, 1933; U.S. citizen; Master in Civil Engineering, University of Illinois; Deputy Director, Office of Planning and Programming, Illinois Department of Transportation; responsible for long-and short-range transportation plans and programs for highways, railroads, airports, public transportation, and inter-city people travel. Primary transportation interests: transportation planning and programming.

ATCHISON, Harvey R., born September 12, 1936; U.S. citizen; B.S. Colorado State University; graduate work in landscape architecture, University of Oregon; Director, Division of Transportation Planning, Colorado Department of Highways; work involves administrative activities concerning formation and evaluation of policies/objectives for the division; performs operational planning, policy implementation, budgeting, staffing, systems planning, and other related duties in the division. Primary transportation interests: planning finance, management.

BOWSER, Lee H., born June 13, 1949; U.S. citizen; Masters in Regional Planning, Pennsylvania State University; Bachelor Urban/Regional Planning, Indiana University of PA; Director, Program Development and Management, Pennsylvania Department of Transportation; administers and coordinates the Department of Transportation's project selection, resource allocation, and project authorization process between the Department's Program Management Committee and other department executives and operating divisions; reports directly to the Deputy Secretary for Transportation Planning. Primary transportation interests: program development and management, techniques and organization approaches.

FAUSCH, Peter A., born November 4, 1941; U.S. citizen; Bachelor of Civil Engineering, University of Minnesota; Certificate, Yale University, Bureau of Highway Traffic; Assistant Commissioner, Planning Division, Minnesota Department of Transportation; responsible for development and maintenance of State Transportation Plan; heavily involved in development and continued improvement in the legislation-financial-capital program development planning cycle. Primary transportation interests: statewide, multimodal transportation planning; participation criteria for capital program development; strategic management of resources.

FELL, Charles D., born September 22, 1939; U.S. citizen; B.S. Industrial Engineering, Lehigh University; Chief, Bureau of Capital Programming and Monitoring, New Jersey Department of Transportation; responsible for the development of N.J. DOT capital programs, the processing of federal aid and project documents for FHWA approval, and the monitoring of project status and progress. Primary transportation interests: programming, management, and finance.

GAUSMANN, Arne L., born October 18, 1922; U.S. citizen; attended college; Director of System Planning, Wisconsin Department of Transportation. Primary transportation interests: planning, travel forecasting, TSM,

surveillance and monitoring, metro and regional planning.

HILLIARD, William M., born November 28, 1936; U.S. citizen; Master of Business Administration, Florida State University; Bachelor of Civil Engineering, Georgia Institute of Technology; Deputy Director for Financial Administration, Florida Department of Transportation; with responsibility for programming, budgeting, financial management, contracts, fiscal, and data programming. Primary transportation interests: planning, programming, budgeting, finance, and management.

HUMPHREY, Thomas F., born November 5, 1937; U.S. citizen; M.S. Civil Engineering, University of Massachusetts; B.S. Civil Engineering, Worcester Polytechnic Institute; one-year non-degree program, Cornell Graduate School of Business and Public Administration; Senior Research Associate, Massachusetts Institute of Technology. Primary transportation interests: planning, programming, administration/management, energy, and finance.

KASSOFF, Hal, born June 13, 1943; U.S. citizen; Master of Science, Northwestern University; Bachelor Civil Engineering, C.C.N.Y.; Director, Office of Planning and Preliminary Engineering, Maryland State Highway Administration; with responsibilities for developing the highway element of the MDOT 6-year consolidated transportation program. Primary transportation interests: programming, project development, and planning.

LANDERS, F. Worth, born August 23, 1927; U.S. citizen; B.S. Civil Engineering, University of Maine; Certificate, Traffic Engineer Seminar, Northwestern University, Evanston, IL; Commissioner of Public Works, City of Worcester, MA. Primary transportation interests: planning, financing, constructing and maintaining city street and bridge system.

MACGILLIVRAY, Colin Ian, born September 25, 1938; U.S. citizen; Master Civil Engineering, Purdue University; Bachelor Civil Engineering, University of Alberta (Canada); Director, Planning and Research, Iowa Department of Transportation; responsible for policy, system and project planning, and fiscal planning, needs studies, and programming for all modes of transportation as related to state program. Primary transportation interests: national and state transportation policy, programming of resources, financing, statewide systems planning, transportation economics, transportation and economic development.

OCKERT, C. William, born July 7, 1938; U.S. citizen; Master in Transportation Planning; Bachelor in Civil Engineering; MPO Secretariat, Office of Transportation Administration; responsible for overall administration of Dade County MPO transportation planning program. The program establishes priorities for transportation improvements. Primary transportation interests: urban transportation planning, finance, and programming.

REED, Marshall F., Jr., born November 7, 1931; U.S. citizen; B.S. Civil Engineering, Duke University; Transportation Engineer, Highway Users Federation; author of many publications. Primary transportation interests: effective use of transportation funds in federal, state, and local government.

SKOLNICK, Marilyn, born January 17, 1925; U.S. citizen; M.A. Anthropology, B.A. Geology, University of City of

New York; post graduate work in anthropology, University of Iowa; Director of Urban Policy/Transportation of the League of Women Voters of Pennsylvania; responsible for keeping the 66 local leagues informed about transportation in Pennsylvania. Primary transportation interests: planning, finance, management, and the role of citizen participation in all aspects related to transportation.

SWIETYNIEWSKI, Robert W., born November 19, 1940; U.S. citizen; Mayor of Olmsted; President, Ohio Association of Regional Councils; President, Northeast Ohio Area-wide Coordinating Agency (NEOACA) Policy Board; Chief Executive Officer, North Olmsted Municipal Bus Lines; Chairman (NEOACA) Air Quality Planning Policy

Task Force; Chairman (NEOACA) Environmental Development Committee; Executive Committee, Cuyahoga County City of Mayors and Managers Association; Member (NEOACA) Transportation Advisory Committee/Transit Coordinating Committee.

WILLIAMSON, R. S., Jr., born November 27, 1923; U.S. citizen; B.S. Civil Engineering, Texas A&M University; Engineer of Design Operations, Texas State Department of Highways and Public Transportation; responsible for development of 1-year letting schedule and monthly letting including programming. Primary transportation interests: planning and development of 20-year project development and control plan; 1-year letting schedule and monthly letting schedule, monitor plan, Section 105 annual programming and financing.

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